SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XLIV FEBRUARY, 1927 NUMBER 2

SURGERY OF THE NERVES OF THE HAND[1]

BY STERLING BUNNELL, M.D., SAN FRANCISCO

IT is the purpose of this paper to show that the nerves of the hand and fingers are important and that their repair by surgery is unusually satisfactory. Of all nerve sutures throughout the body those that are the most uniformly, promptly and completely successful are of the hand and fingers.

Considering this, it is the more surprising that in a search through the literature I have not been able to find mention of suture of nerves below the wrist. Perhaps the natural presumption is that these are too small to be sutured.

After repairing one hundred and five nerves of the hand and fingers, largely in the course of operations on the tendons,[2] the fact has been impressed upon me that if the ends of these nerves are accurately approximated, very good regeneration always follows. Although it is risky to use the word "always" in surgery, in this instance it seems fully justifiable.

The exceedingly good results following suture of nerves in the hand are due to two factors. One is that the nerves there are no longer mixed, but are either purely motor or purely sensory. The other factor is that the regenerative power of the nervous system increases as we approach the periphery. In the central nervous system where there is no neurilemma, axones do not regenerate. In the periphery, however, nerve fibers even penetrate and restore sensation in whole thickness skin-grafts.

IMPORTANCE OF FUNCTION OF NERVES IN HAND

The two major functions of the hand are motion and sensation, and these are of equal importance. Without sensation in the hand, a manual worker is greatly crippled, especially if the area be in the distribution of the median nerve, as this constitutes the principal tactile part of the hand. The pulps of the thumb and first two fingers are particularly important because of their specialized use.

Severance of a volar nerve at the base of a finger results in anæsthesia of that half of the finger on its volar surface and in the last one or two distal segments on its dorsal surface, while severance of a digital volar nerve in the palm causes anæsthesia in the half of each finger bordering the cleft.

Without sensation, a worker can scarcely pick up a small object, and he constantly drops things from his grasp. The so-called eyes of his fingers are blind. He cannot find or distinguish an object with his hand without looking at it. His joint sense also suffers and he is awkward and fumbles. He frequently burns and injures his fingers.

The power to oppose the thumb to the fingers is usually lost, if the tiny motor thenar nerve is severed, and, if the deep branch of the ulnar nerve is cut, a claw-hand results, with weakness of the grasp of the thumb and inability to spread the fingers. Although these nerves are small, they are important from a social standpoint as their loss may cause

[2] Reconstructive surgery of the hand. Surg., Gynec. & Obst., 1924, Sept.

[1] Presented before the Clinical Congress of the American College of Surgeons, Montreal, October 27, 1926.

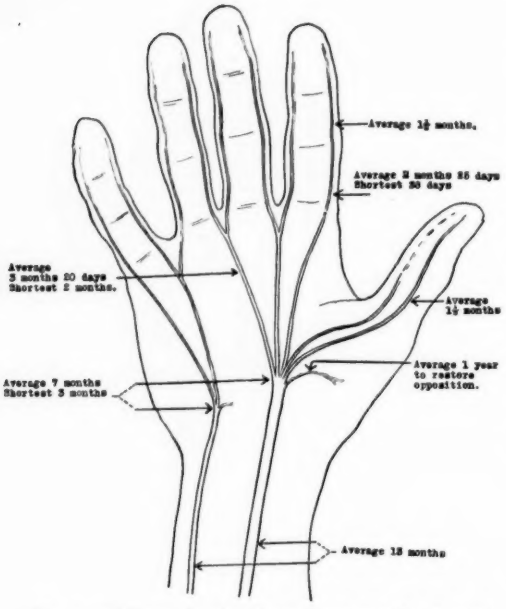


Fig. 1. Diagram showing the average and the shortest time taken in this series, to restore sensation to cotton wool and pin prick over the entire area formerly anæsthetic, including the finger tips. The arrows indicate the points at which the nerves were sutured.

almost any degree of disability in a manual worker.

Atrophic fingers tend to stiffen in the joints and to atrophy in all their tissues until they are reduced to insensitive hooks.

In reconstructing hands, it is most important when nerves to a finger are severed first to repair the nerves and await good regeneration before attempting operations on these fingers or putting tendon grafts in place. In such atrophic fingers, wounds do not heal well, and tendon grafts will become adherent and degenerate and will even break.

TIME OF REGENERATION

In nerves sutured in the proximal part of the palm an average of 7 months was required to restore sensation to pin prick and cotton wool over the entire area formerly anæsthetic, including the finger tips. The shortest time was 3 months. This compares favorably with nerves sutured above the wrist which, in my series, required on the average 13 months.

Nerves sutured in the distal part of the palm required an average time of 3 months and 20 days, and the shortest time was 2 months.

In the proximal segments of a finger, the average time to regenerate was 2 months and 25 days, the shortest time being 38 days for the axones to grow the length of the finger.

In the middle segments of fingers and proximal segments of thumbs the average time was 1½ months. Nerves were not sutured beyond the distal crease in the fingers.

As a rule it may be said that sensation after nerve suture of the volar digital nerves is restored at the rate of the length of a finger segment a month. The speed of regeneration in palmar or finger branches is the same for median and ulnar nerves and the same in the thumb as in the fingers.

FACTORS INFLUENCING SPEED OF REGENERATION

The cases in this series were checked to determine if the speed of regeneration were

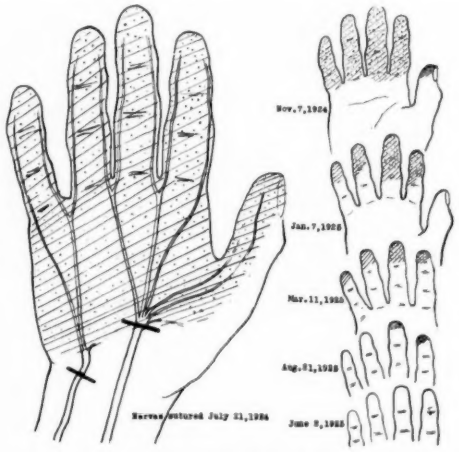


Fig. 2. A. L., age 54. Five months previously a forest bit entered the front of the wrist. This and the infection that followed destroyed all of the tendons and nerves in the front of the wrist. The ends of the ulnar nerve were separated by an inch and the median by 3 inches. Nutrition of the hand was poor. On July 21, 1924, the two nerves were sutured where indicated and nine tendon grafts from the extensors of the toes were used to bridge the tendons. Anæsthesia to cotton wool (shaded) and analgesia to pin prick (dotted) receded, as shown by the dates on the diagrams. The power of opposition returned to the thumb, as it does in about 60 per cent of repairs by suture of the median nerve.

influenced by the length of time between accident and nerve repair. This time averaged 4 months and in only six did it exceed 1 year, the longest being 4 years. The factor of time elapsed was found to have no influence on the speed of regeneration.

The age factor had a moderate influence, in that the ages of the slowly regenerating group averaged 31, of the group of medium speed 25, and of the group of rapid regeneration 21. Age is not of sure prognostic value, however, as some of the old people showed rapid and some of the young showed slow regeneration.

The factor of greatest influence of all was the state of nutrition of the hand. If the hand had been ravaged by past infection so that congealed tissue resulted in which the cicatrix strangled the nerves, lymphatic and blood vessels, causing poor nutrition, the regeneration of the nerves was on the average slower and not so complete. Thus, in the group of rapidly regenerating nerves the nutrition of the hands was in the proportion of fourteen good and four poor. In the group of medium speed there were nine good and six poor, and in the group of slow regeneration there were six good and as many as nine poor. If we divide out these fractions, $\frac{14}{4}$, $\frac{9}{6}$, and $\frac{9}{9}$, we

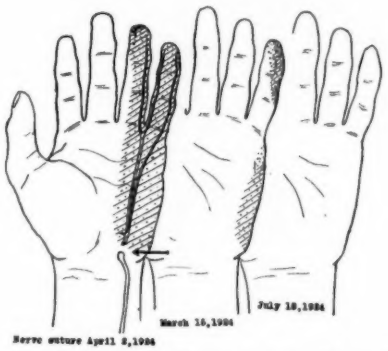


Fig. 3. F. R. S., age 44. Twenty-one months previously the ulnar nerve was severed on a bottle just proximal to its branches, and was sutured on April 2, 1924. The dates on the diagram show how the anæsthesia to cotton wool (shaded) and analgesia to pin prick (dotted) receded.

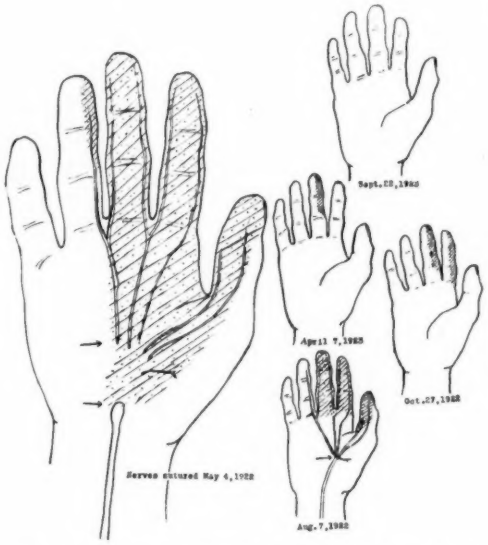


Fig. 4. E. C., age 25. While a bottle was being corked a month previously, the glass neck broke and severed two tendons and the median nerve where it branched. On May 4, 1922, each of the six branches were sutured to the end of the median nerve. Anæsthesia to cotton wool (shaded) and analgesia to pin prick (dotted) receded, as shown by the dates on the diagram. Full ability to oppose the thumb was regained in 11 months through suture of the motor thenar nerve.

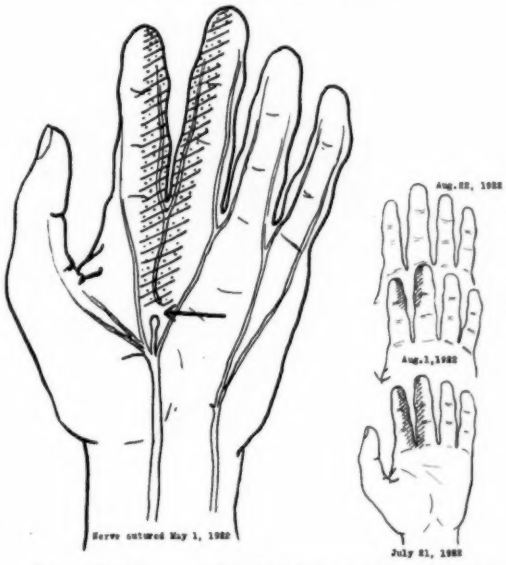


Fig. 5. E. P., age 31. Sixty-five days previously the palm of the hand was lacerated on a milk bottle and the tendons and one of the volar digital nerves were severed. The nerve was sutured on May 1, 1922, and by the dates on the diagrams is shown the recession of the anæsthesia to cotton wool (shaded) and analgesia to pin prick (dotted).

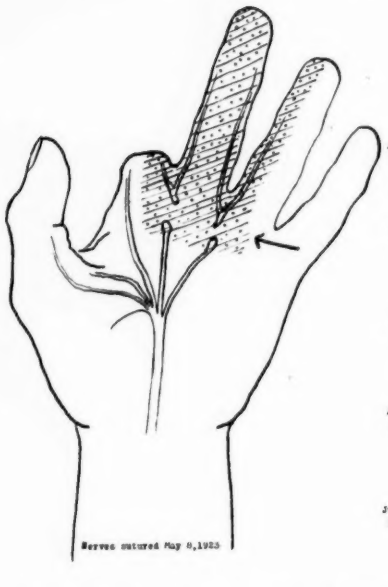


Fig. 6. D. B., age 47. Seven months previously a buzz saw cut across the distal part of the palm. Two volar digital nerves in the palm were sutured, and the anæsthesia to cotton wool (shaded) and analgesia to pin prick (dotted) receded, as shown by the dates on the diagrams.

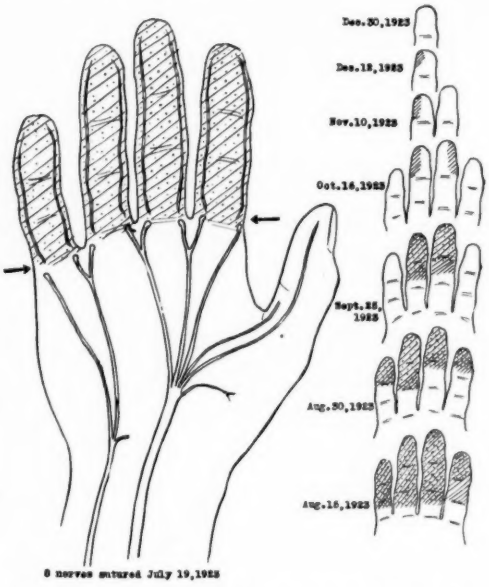


Fig. 8. J. T., age 25. Forty-two days previously, the hand was caught under the sharp edge of a large rotating pipe and every flexor tendon and every volar nerve was severed at the base of each finger, and the fingers were rendered useless. The eight volar nerves were sutured on July 19, 1923. Their ends were approximated by flexing the fingers. The anæsthesia to cotton wool (shaded) and the analgesia to pin prick (dotted) receded, as shown by the dates on the diagrams. On December 15, 1923, the remains of all the flexor tendons were removed from the four fingers and in their places free grafts of the sublimus tendons were used to prolong the profundus tendons to the ends of the fingers. This operation had to be delayed until the nerves had regenerated or else it would have failed from lack of trophic supply. Good sensation and motion were obtained in each finger. Eventually the fingers could flex almost to the palm.

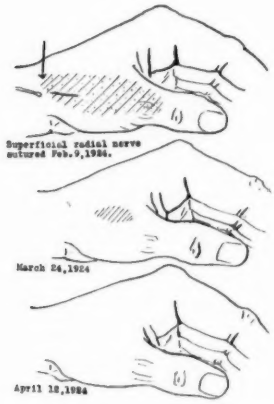


Fig. 7. C. M. S., age 49. Six months previously a knife severed the short extensor tendons of the thumb and the superficial radial nerve. The tendons and nerve were repaired on February 9, 1924. On March 24, 1924, he could feel pin prick (dotted) throughout, and on April 12, 1924, could feel cotton wool (shaded) throughout.

have as the factor that nutrition plays 3.5, 1.5, and .66 for the rapidly, medium, and slowly regenerating cases respectively. Therefore, the speed of regeneration was uninfluenced by the length of time between accident and repair, moderately influenced by the age factor, and greatly influenced by the state of nutrition of the hand.

ORDER OF SENSATIONS IN REGENERATION

As the nerves of the hand regenerate, sensations are restored usually progressively down the palm and digits. Coarse touch advances first, followed by sensation to pin

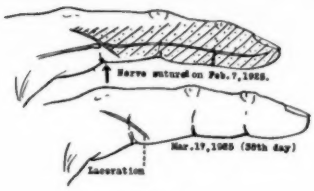


Fig. 9

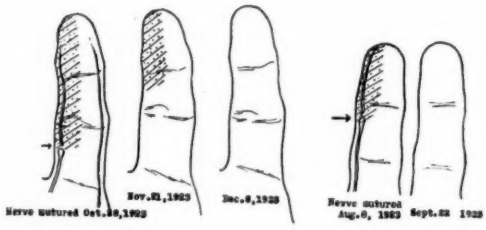


Fig. 10 Fig. 11

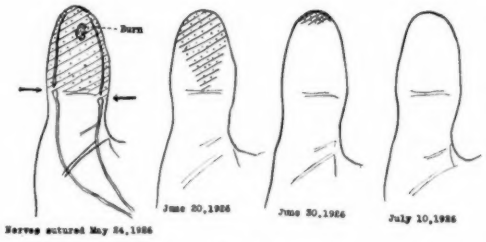


Fig. 12

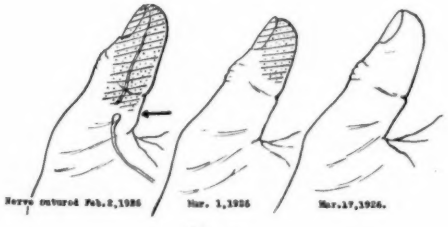


Fig. 13

Fig. 14

Fig. 15

Fig. 11. Miss E. C., age 16. Three months previously one volar nerve of the long finger was cut by an electric fan. The nerve was sutured on August 8, 1923, and 45 days later cotton wool and pin prick could be felt over the area of the pulp which had been anæsthetic.

Fig. 12. J. L., age 28. Three months previously both volar nerves of the thumb were cut with a knife and the pulp of the thumb became anæsthetic and interfered with patient's work. The nerves were sutured on May 24, 1926, and the anæsthesia to cotton wool (shaded) and analgesia to pin prick (dotted) receded, as shown by the dates on the diagram.

Fig. 13. Mrs. G. A. J. Six months previously the volar nerve on the radial side of the thumb was cut on a glass jar and the important tactile area of half the pulp of the thumb rendered insensitive. The nerve was sutured on February 2, 1926. Anæsthesia to cotton wool (shaded) and analgesia to pin prick (dotted) receded, as shown by the dated diagrams.

Fig. 14. Miss S. P. Six months previously a laceration in the index finger resulted in tenosynovitis and an abscess in the thenar space. The latter was drained through an incision in the palm at the base of the thenar eminence. As the thenar branch of the median nerve was severed the apponens pollicis and abductor pollicis muscles were paralyzed and had become atrophied so the thumb could no longer oppose the fingers. On August 4, 1924, this tiny nerve was sutured where shown in the diagram, with full recovery of the power of opposition 13 months later The photograph, Figure 15, shows that the thenar muscles are functionating well and their atrophy has gone.

Fig. 15. Photograph of hand shown in Figure 14.

Fig. 9. J. B. H., age 30. Eighteen days previously the volar nerve on the radial side of the index finger was severed with a chisel. It was sutured on February 7, 1925, and on March 17, 1925, only 38 days later, cotton wool and pin prick could be felt over the entire area which had been anæsthetic.

Fig. 10. J. C., age 21. Four months previously the volar nerve on the ulnar side of the index finger was severed with a knife. The nerve was sutured on October 28, 1923. The area insensitive to cotton wool (shaded) and pin prick (dotted) receded, as shown by dates on diagram.

prick. The latter is followed quite closely or accompanied by that to cotton wool touch. Tinel's sign follows down the axones fairly well and there is usually no tender neuroma left at the site of suture. A tingling or tickling paræsthesia or hyperæsthesia is felt over the area of newly acquired sensation, but this usually disappears after a year, although in

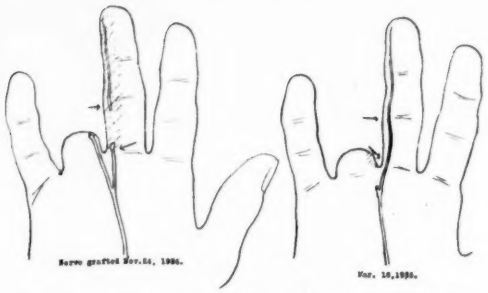


Fig. 16. H. D. N., age 36. Sixty-nine days previously a steam-shovel amputated the ring finger and removed a segment of the volar nerve from the adjoining side of the long finger. On November 24, 1924, the three-quarter inch gap in the nerve of the long finger was bridged by a free graft (shown in solid black between the arrows) from the volar nerve of the amputated finger. Anæsthesia to cotton wool (shaded) and analgesia to pin prick (dotted) left the long finger in 4 months.

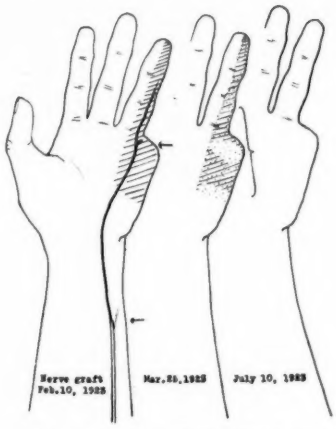


Fig. 17. J. K., age 26. Eight months previously the wrist was lacerated on a wind shield and a severe infection followed, necessitating amputation of the little finger. As a length of the ulnar nerve had sloughed, a strand of sural nerve from the leg was used as a six-inch graft to bridge the ulnar nerve, as shown in black between the arrows in *a* on February 10, 1923. Three and one half months later coarse touch could be felt opposite the bracket in *b* and the area insensitive to cotton wool (shaded) and pin prick (dotted) had reduced in patches. In 5 months these sensations could be felt throughout, as in *c*, and in 10 months after the nerve suture enough stereognosis had returned to distinguish a cotton applicator, a piece of gauze, and a piece of metal, though he could not differentiate between a coin and a key.

cases of poor nutrition it may persist longer. Occasionally axones become crossed, so that at first the touch of one finger may be referred to another.

The trophic effect of a severed nerve commences to leave a finger as the sensation is restored, so that in most cases it leaves entirely and the finger throughout its tissues is restored to as near normal as the general condition of the hand allows.

Stereognosis usually returns within a year in the case of sutured volar digital nerves and for nerves sutured in the proximal part of the palm the time averaged 16 months, reaching the degree of distinguishing a key, knife, pencil, half dollar, or dime.

NERVE GRAFTS

Of nerve grafts in the hand, there were six cases, and contrary to a prevalent belief all were successful. Several were 6 and 7 inches long from the sural nerve in the leg and in every case sensation to light touch and pin prick and even some degree of stereognosis returned in almost the usual time and degree as after a simple nerve suture.

An interesting example is a case of 4 years' standing in which a 6-inch gap in the median nerve in the palm and forearm was bridged by a single strand of sural nerve, with return of sensation in over half the anæsthetic area. Being encouraged by this we added 6 months later two more strands of sural nerve from the other leg, thus making a three-ply 6-inch graft. In 11 months he felt light touch and pin prick over the entire area and identified a half dollar and called a knife a key. At the end of 1½ years, stereognosis was good and although his fingers moved largely through six tendon grafts he was able, by feeling, to tie his shoe laces, shave, write, and pick up a match with that hand.

Anæsthesia from the loss of the sural nerve was not complained of.

ETIOLOGY

Of the different weapons or agents causing severance of nerves of hand and fingers, my list numbers fifteen, the most frequent of which in order were glass bottles, buzzsaws, ill-chosen surgical incisions, and sloughing from infection.

From this it will be noted that the danger of severing nerves in the hand by surgical

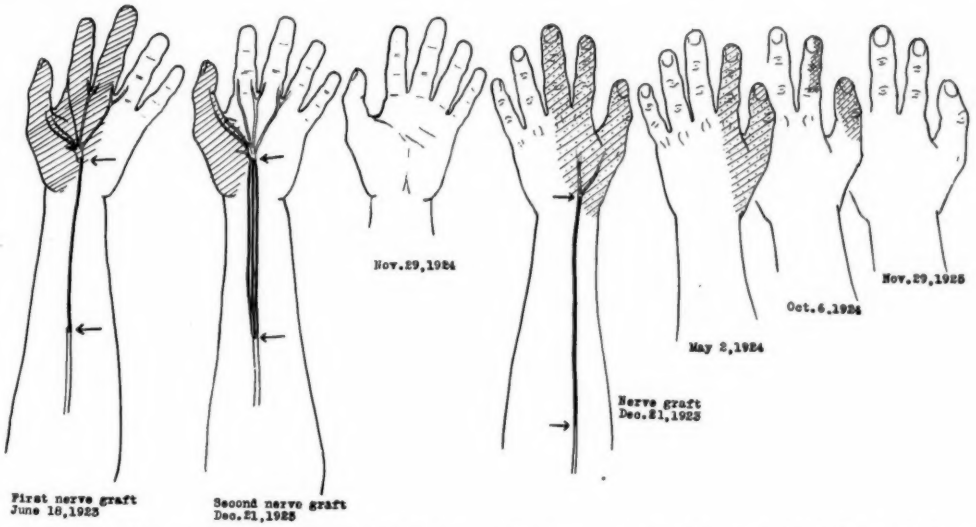


Fig. 18 (left). E. B., age 23. Four years previously a buzz saw passed two-thirds through the carpus from the radial side and a considerable length of the median and radial nerves and most of the tendons sloughed out. On June 18, 1923, while joining the flexor tendons with grafts from extensor tendons of the foot, we grafted a single strand of sural nerve 6 inches long between the median nerve in the forearm and its distal end in the palm as shown between the arrows in *a*. The anæsthetic area diminished, as shown in *b*. So encouraged by this, we grafted two more strands of sural nerve from the other leg 6 months later (December 21, 1923) making a three-ply 6-inch graft. In 11 months he felt light touch and pin prick over the entire area and identified a half dollar, and called a knife a key. At the end of 1½ years stereognosis was good and though his fingers moved largely through six tendon grafts he was able, by feeling, to tie his shoe laces, shave, and pick up a match with that hand.

Fig. 19. E. B. (same case as in Figure 18). On December 21, 1923, while supplying tendon grafts for the thumb and extensors of the wrist, we used a 6-inch graft of sural nerve to join the ends of the superficial radial nerve as shown between the arrows. The area of anæsthesia shown is extensive for this nerve as the median nerve was also severed. The anæsthesia to cotton wool (shaded) and pin prick (dotted) receded, as shown by the dates on the diagrams. The patient did not complain of any anæsthesia resulting from the loss of the sural nerve.

incision is a real one. In the fingers, incisions should be midlateral to avoid this and not at the junction of the volar and lateral surfaces, as is so often illustrated. In incising the palm for thenar abscess, the knife, when unthinkingly the operator draws it too far proximally, has frequently cut the thenar nerve, greatly crippling the hand. Nerves in the hand are in so much danger of being cut that in our dissections or incisions the limb should first be rendered ischæmic by a tourniquet.

TENDER AMPUTATION STUMPS

Stumps of finger amputations are frequently so sensitive that they render a hand unfit for work because the strong tendency of peripheral nerves to regenerate results in neuromata. The stumps are tender in two spots corresponding to the ends of the volar nerves. These are easily remedied by locating the neuromata on each side, drawing out the two volar nerves, injecting with alcohol, and cutting off the neuromata.

Of the 105 nerves repaired 60 were in the hand and 45 in the fingers and thumb. Included in these were several sutures of the superficial radial, dorsal branch of ulnar, deep branch of ulnar, and thenar branch of median. The latter, which is the smallest nerve suture, was done three times with complete regeneration of the thenar muscles and return in an average of a year of good ability to oppose the thumb to the fingers. In one case all eight volar digital nerves were sutured at the bases of the fingers in one operation with return of sensation throughout.

The suturing of digital nerves is done with a No. 16 straight Kirby needle and the finest

of silk thread. Counting two guide sutures, six sutures in all are placed, catching the sheath only. Accuracy is, of course, essential. To minimize the amount of foreign body in the apposition stitches the silk may be split by untwisting into two or three strands and one of these separate strands can be used.

In suturing several nerve branches to a single nerve, as in joining all of the six branches of the median nerve in the palm to the main nerve, it is best to first unite all of the branches together with a central stitch in their sheaths so they will be grouped together like one nerve and then to complete the suture in the usual manner. Gaps between nerve ends are best overcome by flexion of fingers and wrist and by slow return of extension after a month. In order to overcome a gap the length of the palm, the median and ulnar nerves must be freed well up the arm. Length is gained in the median nerve by flexing the elbow and in the ulnar nerve by transplanting it to the front of the elbow.

CONCLUSION

Loss of function of the nerves of the hand and fingers is of vital importance to the manual worker, as the resulting disability is great. These nerves are readily repaired by surgery and will regenerate more uniformly, promptly, and completely than after any other nerve repair.

THE PRESENT STATUS OF CHOLECYSTOGRAPHY AND REMARKS ON THE MECHANISM OF EMPTYING OF THE GALL BLADDER[1]

By EVARTS A. GRAHAM, M.D., St. Louis
From the Department of Surgery, Washington University School of Medicine and Barnes Hospital

THE story is told that when Robert Koch was asked, soon after his discovery of the tubercle bacillus, if he did not think that the problem of tuberculosis would soon be settled, the great bacteriologist replied that the problem of tuberculosis resembled the mythical nine-headed hydra in that every time one head was cut off two new heads appeared. The same analogy can be drawn in regard to all other scientific problems; and the incompleteness of knowledge constitutes the lure which beckons on the modern Hercules and attracts him irresistibly into the scientific swamp of Lerna. The gall bladder has recently responded to the lusty decapitating strokes of many a would-be Hercules by the production of a frightful number of new heads leering at us defiantly from their bed of green slime.

In the limited scope of a paper like this, it will not be possible to discuss fully all of the recently acquired knowledge of the gall bladder or even the new problems which have been the offspring of this recent knowledge. I hope I shall be pardoned, therefore, if my remarks are confined chiefly to those problems which have interested my associates and myself, and more particularly to the questions of the diagnosis of gall-bladder lesions by cholecystography and the mechanism of emptying of this organ.

CHOLECYSTOGRAPHY

Cholecystography is now 3 years old. Although still an infant, its voice seems to have been strong enough to have attracted attention abroad as well as in its own household. For this reason it seems proper for one of its parents to take calm notice of the gossip about his child, both good and bad, in order that as many faults as possible may be corrected in early youth. Let it be understood also that the parents of this child do not regard their offspring as perfect but, on the contrary, as possessing many of the ordinary frailties of infancy and childhood.

In the numerous publications which my associates, Warren Cole, Glover Copher and Sherwood Moore, and I (13) have made on this subject we have repeatedly called attention to the principles which underlie the procedure as a diagnostic test. But, because of the frequent appearance of misconceptions in the literature, it seems well to restate these principles. Theoretically, any substance used for cholecystography must be excreted by the liver into the bile. It must pass with the bile into the gall bladder where it must be concentrated by the absorption of water in order to give the densest shadows. It is obvious, therefore, that the densest shadows will be found in normal subjects. It is equally apparent that there may be no shadow at all, or only a faint one, if the cystic duct is occluded, if the gall bladder is unable to concentrate its contents because of a diseased wall, or if the liver is unable to excrete the substance normally. Moreover, as bile is poured out from the gall bladder into the common duct, it is obvious that the shadow will diminish in size and gradually disappear entirely. Since the presence of food in the duodenum is accompanied by an outpouring of bile, the necessity of fasting during the period of concentration of the substance in the gall bladder becomes evident. It is seen, therefore, that cholecystography is really a means of studying the functional activity of the gall bladder rather than a means of indicating the exact pathological lesions present. In spite of this fact, however, many writers speak erroneously of an absence of shadow as a "failure of filling" of the gall bladder and conclude that there must be an actual physical blocking of the cystic duct; and if no calculi are found at operation, then the existence of a hypothetical spasm of the cystic duct is supposed. So far as I know, however, no one has ever demonstrated the existence of a spasm of the cystic duct. Another error mentioned by some is

[1] Presented before the Clinical Congress of the American College of Surgeons at Montreal, October, 1926.

that although the results of a cholecystographic examination seemed normal, nevertheless at operation thick, tar-like bile was found in the gall bladder as if this were an abnormal finding. On the contrary, of course, the presence of thick tar-like bile is an indication that the gall bladder has been carrying out its function of concentration, and it may be merely a normal finding.

Cholecystography, however, provides a means of investigating the only functions of the gall bladder which are known at present, namely the ability to concentrate its contents, as revealed by an increasing density of the shadow, and the ability to store bile, as shown by changes in size of the shadow. We feel, therefore, that since it is a functional test it also affords evidence of even early and comparatively mild inflammatory disturbances. But not only has it been useful in diagnosing cholecystitis, it has also been the means of recognizing many more cases of calculi than has been possible by the ordinary X-ray examination, of revealing pericholecystitis and pericholecystic adhesions, of positively identifying shadows seen on a plain film as being related to the gall bladder or not, and of showing various anomalies and abnormalities, such as diverticula, double gall bladder, etc.

In our own experience in a total of 1,246 patients examined by cholecystography, the gall bladder has been removed and subjected to microscopic examination in 147 cases. In 143 of these 147 cases the X-ray diagnosis has been confirmed showing a percentage of correctness of 97.28. It is, of course, realized that this figure of 97 per cent of diagnostic efficiency for the method may not be strictly accurate, based as it is only on those cases in which cholecystectomy was performed, since it is possible that some of the cases, regarded as normal and therefore not subjected to operation, may have had some actual disease of the gall bladder. In the few cases, however, in which abdominal operations for other conditions have permitted us to examine gall bladders diagnosed normal by cholecystography, our experience leads us to believe that approximately the same percentage of correctness will hold for the normal as for the pathological cases.

The experience of others as quoted in the literature is given in Table I. Only those results are presented which have been verified by operation. It is possible also that some published series have been overlooked. The results in a total of 561 cases are given in which the gall bladder was examined at operation.

Table I shows that in 446 cases reported in the literature, including our own, in which gall bladders diagnosed as pathological by cholecystography were examined at operation, only 10 were found not to corroborate the X-ray diagnosis. Thus the total percentage of correctness in these cases has been 97.8. It has been very surprising to us that this high figure, only 2.2 per cent short of perfection, should have been reached in this early period of development of the method and at the hand of many different observers. It is probable that as experience with the procedure grows the percentage of correctness will increase still further. In fact several of the authors quoted in the table are of the opinion that in some of the cases in which the surgeon considered the gall bladder to be normal, contrary to the X-ray diagnosis, there was much doubt about the correctness of his opinion.

The criteria of interpretation of a normal and of an abnormal gall bladder respectively have been given so frequently in other publications that they will not be mentioned here, except to state briefly that a failure to obtain any shadow after the use of the intravenous method is the most certain indication of disease of the gall bladder. The most difficult interpretations are in those cases in which there seem to be variations from the normal in faintness of shadow and in delay of disappearance. It is in this type of case that we have had our only errors in diagnosis.

In a brief article like this it will be impossible to discuss the many modifications of the procedure which have been proposed and carried out by various workers. To Menees and Robinson (22) of Grand Rapids belongs the chief credit of popularizing the oral method. Our own preference, however, is still for the intravenous method, and we adhere rather closely to the technique which we have described from time to time in our vari-

TABLE I.—CASES REPORTED IN WHICH CHOLECYSTOGRAPHIC EXAMINATION HAS BEEN COMPARED WITH OPERATIVE FINDINGS

Author	Method of administration	Diagnosis of normal gall bladder			Diagnosis of pathological gall bladder			Total percentage of correctness of diagnosis
		Normal gall bladder at operation	Pathological gall bladder at operation	Percentage of correctness of cholecystography	Normal gall bladder at operation	Pathological gall bladder at operation	Percentage of correctness of cholecystography	
Sosman, Whitaker and Edson (24)	Intravenous	4	1	80	1	37	97.3	95.4
Carman (6)	Intravenous	0	9	0	0	41	100	78
Carman (6)	Oral	21	18	53.9	0	103	100	87.3
Cohen and Roberts ( )	Intravenous	2	0	100	1	7	87.5	90
Wilkie and Illingworth (27)	Intravenous	21	2	91.3	0	32	100	96.4
Gosset and Loewy (12)	Mostly Intravenous	21	0	100	1	10	91	96.9
Stewart and Ryan (25)	Oral	1	0	100	2	21	91.3	87.5
Jewett (15)	Oral	2	0	100	1	10	91	92.4
Winslow and Melgard (28)	Intravenous	1	0	100	0	6	100	100
Nemours-Auguste (23)	Intravenous	3	0	100	0	5	100	100
Kaznelson and Reimann (16)	Intravenous	1	0	100	0	3	100	100
McCoy and R. S. Graham (19)	Intravenous	8	0	100	0	16	100	100
McCoy and R. S. Graham (19)	Oral	0	0		0	2	100	100
Totals of others.....				74				98
Graham, Cole, Copher and Moore	Mostly Intravenous				4	143	97.3	97.3

Percentage of correctness in 446 cases of all authors with a diagnosis of pathological gall bladder = 97.8.
Percentage of correctness in 115 cases of all authors with a diagnosis of normal gall bladder = 74.
Percentage of correctness in 380 cases of all authors by intravenous method = 95.
Percentage of correctness in 181 cases of all authors by oral method = 89.

ous publications. It will be seen also from the table that other workers who have used the intravenous method have in general obtained a higher percentage of correct results than those who have used the oral method. Stewart and Ryan (25), however, are to be particularly congratulated on the excellence of their results with the oral method. The most serious objection to the administration by mouth of any substance for cholecystography is the uncertainty of whether a sufficient amount has been absorbed to reveal the gall bladder in any case in which there has been failure to obtain a shadow.

On the other hand the objection to the intravenous method is the fear of either a general toxic reaction or a thrombophlebitis at the site of injection.

The fear of reactions invites a discussion of the toxic effects of those substances which we now know are capable of making the gall bladder visible. An ideal substance for cholecystography would, of course, be one which would have no toxic effects. Unfortunately such has not been found. We have experimented with 43 different substances of which 12 have been found able to make the gall bladder visible. But all of these in varying degrees have some toxic properties. We are still hoping to find an ideal agent. Up to the present time the one which seems most satisfactory from the standpoint of toxicity is phenoltetraiodophthalein which differs from its isomeric compound, tetraiodophenolphthalein, in the position of the iodine atoms in the molecule. This substance, while being less

toxic, has the disadvantage of being much more expensive. On the other hand, to those who are interested in tests of hepatic function by dye excretion, it can be used for simultaneous cholecystography and tests of hepatic function, since it gives a strong purple color in alkalinized serum. We have been using it for cholecystography almost exclusively during the last 6 months. For the details of its use some of our recent articles may be consulted. Our own experience has shown a marked decline in toxic reactions of all kinds but particularly since we have used phenoltetraiodophthalein. In the last 503 cases there has not been a single instance of severe general reaction. Patients are requested to notice whether any of the following symptoms occur after the administration of the substance: headache, dizziness, nausea or vomiting, weakness, diarrhœa, pain in back or abdomen, chills, "smothering" or "nervousness." If any of these symptoms have occurred the presence of a toxic reaction is recorded. In many instances these recorded reactions have been so slight that they would have escaped notice if the patient had not been warned to look for them. On this basis of what seems to us a generous allowance for reactions, our experience may be summarized as in Table II.

TABLE II

	Intravenous cases	Reaction percentage	Oral cases	Reaction percentage
Tetraiodophenolphthalein	114	66.6	116	67
Phenoltetraiodophthalein	267	35.2	6	50

It will be observed that the percentage of reactions of all kinds after the intravenous use of the newer substance, phenoltetraiodophthalein, has fallen nearly 50 per cent as compared with the intravenous use of tetraiodophenolphthalein, and that it is considerably lower than after the oral administration of either substance. Phlebitis should not occur if the vein is washed with physiological saline or Ringer's solution immediately after the completion of the injection of the substance. If it does occur, the application of heat to the arm usually results in a prompt disappearance of symptoms. It is said that one fatality after the intravenous use of tetraiodophenolphthalein has recently occurred in one of the London hospitals, but I have seen no published details.[1] We have repeatedly cautioned against the use of the intravenous method in patients who are afflicted with severe cardiorenal disease or in the aged. We have also urged the necessity of a pure product, the use of freshly prepared solutions and meticulous care concerning sterility, etc. We have also favored giving the dose in two injections, a half-hour apart, as a safeguard against general reactions. It is well known that organic iodine compounds in general have a tendency to decompose when exposed to air or light. It was because of this fact and the fear that in careless hands some fatalities might occur that we were slow to recommend the iodine compound rather than the tetrabromphenolphthalein, although, as stated in our first report, the first substance which we used for cholecystography was tetraiodophenolphthalein. It is unfortunate that there is no means of controlling the manufacture of the drug so as to insure a standard product of uniform purity. Without that safeguard, it will not surprise us to hear of more fatalities. These substances used for cholecystography will probably run a course very similar to that of salvarsan in its early days before adequate supervision was exercised over its manufacture. Our own experience has been practically confined to the preparations of one firm.[2] Ampoules containing individual doses of the crystals are a safeguard against deterioration from oxidation of the substance by exposure to the air, such as must occur to some degree when the drug is purchased in bulk.

MECHANISM OF EMPTYING OF THE GALL BLADDER

In 1917 Meltzer (21) proposed his now famous theory of the existence of a contrary innervation between the gall bladder and the so-called sphincter of Oddi by which he meant that each opening of the sphincter was accompanied by a simultaneous contraction of

[1] Since sending this manuscript to press a report of this fatality has been given by G. P. B. Huddy, of Birmingham, instead of London, as erroneously stated in my text, in the Brit. M. J. of Nov. 6, 1926, p. 864. Although the death seems undoubtedly to have been caused by the injection of the tetraiodophenolphthalein, the dose of 5.5 grams given is nearly twice as large as the maximum dose which we have recommended; furthermore it was given in one injection instead of in two injections as we have repeatedly advised.

[2] The Mallinckrodt Chemical Works of St. Louis.

Fig. 1. Gall bladder of dog containing lipiodol. To prevent the entrance of bile into the gall bladder, the hepatic ducts were ligated at the time of the introduction of the lipiodol. In this and all the following figures the X-rays were directed through the side of the animal which was standing on his four feet in the normal position.

Fig. 2. One hour and forty-five minutes after the administration of Boyden's meal of egg yolk and cream and 1 hour and 45 minutes after the picture shown in Figure 1 was made. Some of the lipiodol has reached the intestine but the gall bladder has not diminished in size appreciably.

the musculature of the gall bladder. Noting that magnesium sulphate, when applied to the ampulla of Vater, induced a relaxation of its sphincter with an outpouring of bile, he concluded that this simple agent might be utilized clinically as a means of emptying the gall bladder. On this basis Lyon (18) devised his well known procedure of the non-surgical drainage of the gall bladder. Serious doubts as to the correctness of Meltzer's hypothesis were not raised until recently, and it is really only since the development of cholecystography that we have seen that amazing increase of new heads on our cholecystic hydra alluded to in the opening paragraph.

With a means at hand of seeing the normal gall bladder in the living subject, it was but natural to look for contraction waves similar to the familiar peristaltic waves of other parts of the alimentary canal. But no such waves have been seen, although search has been made fluoroscopically repeatedly both by ourselves and others. Certain rhythmic contractions in the gall bladder were described a long time ago by Bainbridge and Dale (1). We (9) found such contractions but because they occurred synchronously with respiratory movements, it was felt that increases of intra-abdominal pressure caused by respiration were probably responsible for them. The situation was therefore presented of an organ supplied with muscle in its walls in which no observations of contraction which had hitherto been made could be accepted without criticism. But nevertheless there was no justification in drawing a conclusion that this muscle had no power of intrinsic contraction. Much more direct evidence was necessary to determine (1) whether the muscle does contract and (2) if such contractions occur, of how much importance they are in the emptying of the gall bladder. It had been a frequent observation of surgeons that

mechanical stimulation of the living gall bladder elicits no appreciable contraction waves. Thus, pinching with a clamp, incising with a knife, or application of a cautery is followed by no response analogous to that seen in the stomach or intestine. Moreover, even stimulation with an electric current sufficient to cause marked contractions in the intestine or urinary bladder fails to elicit any response in the gall bladder, a finding first recorded by Boyden (2) and Whitaker (26) and later corroborated by us. The older literature contains records of many experiments from which it was concluded that stimulation of the vagus or of the sympathetic induced contractions of the gall bladder, but the methods of experimentation were all open to criticism. More recent work by Copher and Kodama (9), in our laboratory, and also by Whitaker (26), has failed to show any appreciable response in the gall bladder to any nerve stimulation, and Whitaker has made the important observation that, even with both vagi cut, the gall bladder empties in normal time. Also, a fact of great significance is that the normal gall bladder is never found empty. Copher (8) has shown too that if a daily injection of tetraiodophenolphthalein is given to a dog, the gall bladder shadow is always present, demonstrating fairly conclusively that the organ is never entirely empty. These considerations lead very forcibly to the conclusion that the mechanism of emptying must be different from that of the urinary bladder and of the intestine.

What other mechanism can there be? Is it possible to explain an emptying without contraction waves? Winkelstein was one of the first of modern writers to conclude that the emptying is largely a passive process independent of intrinsic contraction of the muscle, and he laid great stress on the changes of intra-abdominal pressure as the force responsible for the emptying. It seems reasonable to suppose that an increase of intra-abdominal pressure would aid in the expulsion of the contents of the gall bladder, provided that the outlet into the duodenum were open; and we have noted a diminution in the size of the visualized gall bladder after deep abdominal palpation. Whitaker (26), however, has recently questioned the possibility of any effect of an increased abdominal pressure, and he states that hydrostatic conditions within the abdomen would prevent it because all of the abdominal contents have approximately the same specific gravity. Specific gravity, however, has practically nothing to do with the question. The important point is the relative resistances of different structures to pressure, i.e., whether the outlet of the common duct would be obstructed by the same pressure necessary to squeeze the gall bladder. This point needs more investigation. But if Whitaker's theory were correct then it would be impossible for the blood to circulate through the abdomen because each pulse wave would be counteracted by transfer of the pressure to a point beyond the wave which would nullify the pulse. However, it seems unsatisfactory to attempt to explain the emptying entirely on the basis of increased abdominal pressure.

Other possible factors in the process of emptying are: (1) a gradual washing out of the gall bladder by the ingress of fresh liver bile, (2) elastic recoil of the overdistended viscus when the pressure in the common duct is suddenly reduced by the opening of the duodenal end of the duct, and (3) absorption of its contents through the wall. The last possibility needs hardly to be considered seriously, since the evidence seems incontrovertible that, except for the absorption of water, the contents of the gall bladder normally pass down the cystic duct and into the intestine.

Boyden (2) has called attention to the fact that the gall bladder contains relatively much more elastic tissue than the intestine; and we (9) have shown that it is mechanically possible for it to empty itself by calling into play the two mechanisms of a gradual washing out by the inflow of fresh liver bile and of elastic recoil. The most decisive experiment bearing on this point was as follows: The gall bladder of a normal dog was removed and for it was substituted a small rubber bag, establishing a connection with the cystic duct by means of a glass cannula. The artificial gall bladder was then encased in a celloidin cylinder in order to obviate the effect of intra-abdominal pressure. After an intravenous injection of tetraiodophenolphthalein, the artificial gall bladder became clearly visualized and gradually lost

Fig. 3. Seven days after the administration of the fat meal. The gall bladder has diminished in size but has not emptied itself of the lipiodol because, as the hepatic ducts had been ligated, the bile could not wash out the gall bladder. During this period of 7 days the dog had food and water constantly in his cage.

Fig. 4. Thirty days after the administration of the fat meal. The shadow appears larger and presents globules, because the ligatures had cut themselves partly through the hepatic ducts permitting some bile to enter the gall bladder and to emulsify the oil in the lipiodol. But not enough hepatic bile was entering the gall bladder to wash out the lipiodol. If intrinsic contractions alone can empty the gall bladder, then it certainly should have emptied itself during 1 month's time. This strongly indicates that the washing out of the gall bladder by the ingress of fresh bile from the liver is an essential part of the mechanism.

its visibility, in a manner quite analogous to what we are accustomed to see in a series of normal cholecystograms. The chief differences from the normal series were that the shadow appeared more slowly and disappeared more slowly. These differences were probably due to an obvious inability on the part of the rubber gall bladder to concentrate its contents, the absence of the factor of intra-abdominal pressure, which probably plays a rôle of some importance in the normal emptying, and the fact that the distensibility and elastic recoil of the rubber bag were not identical with those of the normal gall bladder. Kodama (17) devised an ingenious model to show how it may be possible for the gall bladder to empty itself without the aid of active contractions of its wall.

It is realized, of course, that these findings do not prove that normally the gall bladder empties in the manner described above. But at least they show that it is not necessary to consider active intrinsic contractions of the muscle as essential. They are, however, opposed to the current conception that certain substances, as for example magnesium sulphate and pituitrin, empty the gall bladder by causing a contraction of its walls. But there is no satisfactory evidence that these substances do cause an emptying of the gall bladder, although they may have a minor part in making a shadow of the organ disappear. How then do they act? To answer this question it is necessary to consider the duodenal end of the common duct. In 1879 the American anatomist Gage (11)[1] described a sphincter at the duodenal end of the common duct. Eight years later it was described again by Oddi and

[1] I am indebted to Boyden for the information of the priority of Gage over Oddi.

since then it has generally been known by his name. It is generally agreed that this structure is a factor of great importance in controlling the outflow of bile into the duodenum. Recent anatomical study, however, has shown that it is not always present. Again, as demonstrated by Copher and Kodama, it is unnecessary to assign to the sphincter the chief control of the outflow of bile. It will be recalled that the common duct passes obliquely through the duodenal wall for a considerable distance. According to Quain, in the human, this distance amounts to 2 or 3 centimeters. Contractions of the duodenal wall would therefore tend to occlude the common duct independently of the sphincter at the end. Conversely also relaxations of it would permit bile to flow out unless the sphincter acted independently. Experimentally, bile may be seen to spurt out of the ampulla with each peristaltic wave of the duodenum. The initial relaxation phase followed by the contractive phase of each peristaltic wave would have a "milking" effect on the duct. Each peristaltic wave of the duodenum, therefore, should result in some elastic recoil of the gall bladder itself, by which there would be a spurting out of a little of the gall-bladder bile. Likewise those substances which induce active duodenal peristalsis should be able to effect a diminution in the size of the organ by this means, particularly if it is distended. At any rate the supposedly specific effect of pituitrin and of magnesium sulphate in emptying the gall bladder, seems to us to depend chiefly, if not entirely, on the production of duodenal peristalsis. The effect of intravenous injections of barium chloride in this respect as mentioned by Boyden (3), we have not studied. Possibly it does cause definite muscular contractions. At least Whitaker (26) has shown that intestinal peristalsis alone is not sufficient to induce an emptying of the gall bladder.

From what has been said above, therefore, it is possible that much, if not all, of the importance formerly ascribed to the sphincter of Gage or of Oddi might properly be ascribed merely to variations in tonus of the ordinary duodenal musculature. Strong evidence in favor of this idea has been presented both by Burget (4) and by Carlson (5). A matter of great importance in this connection has been the splendid contribution of Boyden who has shown that a meal of egg yolk and cream will usually effect a disappearance of the normal cholecystographic shadow in a few hours. Sosman, Whitaker and Edson (24) have found that such a meal will reduce the shadow to about one-tenth of its former size within the brief time of 1 hour and 45 minutes. Copher and Kodama have found that oleic acid is even more powerful in this respect. Boyden (3) and also Whitaker (26) in two recent very important articles have published accounts of experiments in which they made use of the fat meal to study further the question of the presence of contractions of the gall bladder muscle. To investigate the question one of the methods which they used was one devised by Whitaker of injecting lipiodol into the gall bladders of experimental animals through laparotomy incisions 24 hours before giving the meal of egg yolk and cream. Lipiodol injected into the gall bladder in this way gives a sharper contrast in X-ray films than any of the substances used for human cholecystography. On the basis of these studies they have produced strong evidence that intrinsic contractions of the wall of the gall bladder occur. Also, additional evidence, obtained by different methods, in favor of the occurrence of contractions has been presented in a recent article by Higgins and Mann (14) and in two others by McMaster and Elman (20). The real question, however, is not whether contractions occur but whether they are able to empty the gall bladder.

It seems unfortunate to me that, in spite of the convincing evidence in favor of intrinsic muscular contractions which these recent authors have advanced, they have concluded that these contractions are practically the only mechanism involved in the process of emptying. Most scientific controversies end in compromise. In our previous publications we have perhaps been a bit too mechanistic in assigning an insignificant rôle to muscular contractions, and major rôles to the washing out of the gall bladder by fresh bile from the liver, to the elastic recoil of the distended viscus, and to changes of intra-abdominal pressure. However, Higgins and Mann, in

spite of the importance which they attach to muscular action, find that only 60 per cent of the contents of the gall bladder are expelled as a result of contractions, and even in these experiments they do not entirely exclude the factor of elastic recoil. McMaster and Elman, as a result of their work, state conservatively "some portion of the gall-bladder contents" is expelled forcibly by contraction of the viscus. Since the appearance of these recent articles we have performed some new experiments which will be reported in detail elsewhere. Brief mention, however, will be made of one type of result. If the emptying of the gall bladder is due exclusively to contractions of its muscle, then even after preventing the ingress of fresh liver bile, it should empty just as well as when fresh liver bile is allowed to flow down into it and wash it out. To test this point Copher, using ether anæsthesia, ligated all the hepatic ducts in two dogs and then injected lipiodol into their gall bladders. On the following day each dog was given by stomach tube a meal of egg yolk and cream, and X-ray films were made at frequent intervals. After the first few hours they were also allowed to eat ordinary meals fed to all the dogs. Both dogs recovered well from the operations. But the shadows of the gall bladder did not disappear in a few hours, as they do in the normal animals after Boyden's meal. On the contrary, in one dog the shadow is still present, 30 days after feeding him the meal. In the other dog it remained for 5 days; and when it was found gone on the sixth day the animal was killed, and it was discovered that the ligatures on the ducts had cut through, resulting in a re-establishment of communication and a flow of bile into the gall bladder. It is true that now, on the thirtieth day, the shadow in the other dog is much smaller than at first, but we strongly suspect that here also communication is re-established and that some bile is entering the gall bladder from the liver. It seems to us that one is forcibly drawn to the conclusion from these experiments that intrinsic contractions of the wall of the gall bladder, aside from the factor of elastic recoil, are not sufficient to empty that organ. We still feel, therefore, as in former publications, that "the gall bladder empties itself of its contents through the cystic duct by the washing out of its contents by bile from the liver, by the elasticity or contractile mechanism of its walls, and by variations of intra-abdominal pressure." In the light of the new evidence we feel that perhaps we have not assigned sufficient importance to the factor of intrinsic contractions of the muscle and that this factor should be added to the physical forces mentioned responsible for the emptying of the gall bladder; but we are unwilling to ascribe to muscular contractions the exclusive rôle in this drama. Thus, one can see the myriad new heads which our cholecystic hydra is developing.

BIBLIOGRAPHY

1. Bainbridge, F. A., and Dale, H. H. The contractile mechanism of the gall bladder and its extrinsic nervous control. J. Physiol., 1905, xxxiii, 138.
2. Boyden, E. A. The effect of natural foods on the distention of the gall bladder; with a note on the change in pattern of the mucosa as it passes from distention to collapse. Anat. Rec., 1925, xxx, 333.
3. Idem. A study of the behavior of the human gall bladder in response to the ingestion of food; together with some observations on the mechanism of the expulsion of bile in experimental animals. Anat. Rec., 1926, xxxiii, 201.
4. Burget, G. E. The regulation of the flow of bile. Am. J. Physiol., 1925, lxxiv, 583.
5. Carlson, A. J. Physiology of the liver: present status of our knowledge. J. Am. M. Ass., 1925, lxxxv, 1468.
6. Carman, R. D. Cholecystography in its application to the diagnosis of cholecystic disease. Lancet, 1925, ccix, 67.
7. Cohen, H., and Roberts, R. E. Radiology of the gall bladder by Graham's method. Brit. M. J., 1925, ii, 54.
8. Copher, G. H. Cholecystography: appearance and disappearance of the shadow. J. Am. M. Ass., 1925, lxxxiv, 1563.
9. Copher, G. H., Kodama, S., and Graham, E. A. The filling and emptying of the gall bladder. J. Exper. Med., 1926, xliv, 65. Also Graham, E. A., Cole, W. H., Copher, G. H., and Kodama, S. Some new phases of the physiology of the biliary tract. Ann. Surg., 1926, lxxxiv, 343.
10. Elman, R., and McMaster, P. D. The physiological variations in resistance to bile flow to the intestine. J. Exper. Med., 1926, xliv, 151.
11. Gage, S. H. The ampulla of Vater and the pancreatic ducts in the domestic cat. Am. Quart. Micr. J., 1879, vol. i.
12. Gosset, A., and Loewy, G. Cholecystographie: épreuve de Graham. Bull. méd., 1925, No. 12, (March 21).
13. Graham, E. A., and Cole, W. H. Roentgenologic examination of the gall bladder: preliminary report of a new method utilizing the intravenous injection of tetrabromphenolphthalein, J. Am. M. Ass., 1924, lxxxii, p. 613; Graham, E. A., Cole, W. H., Copher, G. H., and Moore, S., Cholecystography, an experi-

mental and clinical study, J. Am. M. Ass., 1925, lxxxiv, 14; Cholecystography, the use of sodium tetraiodophenolphthalein, ibid., p. 1175; Cholecystography, its development and application, Am. J. Roentgenol., 1925, xiv, 487; Simultaneous cholecystography and tests of hepatic and renal functions, J. Am. M. Ass., 1926, lxxxvi, 467; Cholecystography, the use of phenoltetraiodophthalein, J. Am. M. Ass., 1926, lxxxvi, 1899; Moore, S., The development and application of cholecystography, Brit. J. Radiol., 1926, xxxi, 283; Graham, E. A., Some recent developments in our knowledge of the biliary tract, Brit. M. J., 1926, ii (Oct. 16), p. 671.

14. Higgins, G. M., and Mann, F. C. Observations on the emptying of the gall bladder. Am. J. Physiol., 1926, lxxviii, 339.
15. Jewett, C. H. Cholecystography by the oral method. Ann. Clin. Med., 1926, v, 185.
16. Kaznelson, P., and Reimann, F. Erfahrungen ueber die roentgenologische Darstellung der Gallenblase mittels Tetrabromphenolphthalein nach Graham-Cole. Klin. Wchnschr., 1925, iv, 1390.
17. Kodama, S. A model to simulate the filling and emptying of the gall bladder. Am. J. Physiol., 1926.
18. Lyon, B. B. V. Non-surgical drainage of the gall tract. Philadelphia: Lea & Febiger, 1923.
19. McCoy, C. C., and Graham, R. S. Experience with cholecystography in cases coming to operation. J. Am. M. Ass., 1926, lxxxvi, 1899.
20. McMaster, P. D., and Elman, R. On the expulsion of bile by the gall bladder; and a reciprocal relationship with the sphincter activity. J. Exper. Med., xliv, 173.
21. Meltzer, S. J. The disturbance of the law of contrary innervation as a pathogenetic factor in the diseases of the bile ducts and the gall bladder. Am. J. M. Sc., 1917, cliii, 469.
22. Menees, T. O., and Robinson, H. C. Oral administration of sodium tetrabromphenolphthalein: preliminary report, Am. J. Roentgenol., 1925, xiii, 368; Oral administration of tetraiodophenolphthalein for cholecystography, Radiology, 1925, v, 211.
23. Nemours-Auguste. Bull. et. mém. Soc. de radiol. méd. de Paris, 1925, cxix, p. 123.
24. Sosman, M. C., Whitaker, L. R., and Edson, P. J. Clinical and experimental cholecystography. Am. J. Roentgenol., 1925, xiv, 495.
25. Stewart, W. H., and Ryan, E. J. The reliability of cholecystography by the oral method as shown by an analysis of one hundred consecutive cases. Am. J. Roentgenol., 1926, xvi, p. 234.
26. Whitaker, L. R. The mechanism of the gall bladder. Am. J. Physiol., 1926, lxxviii, 411.
27. Wilkie, D. P. D., and Illingworth, C. F. W. Cholecystography; a report of fifty-three cases controlled by operation. Brit. M. J., 1925, Dec. 5.
28. Winslow, K., and Melgard, C. Cholecystography and the diagnosis of chronic gall-bladder disease. Northwest Med., 1925, xxiv, 124.
29. Winkelstein, A. The motor mechanism of the gall bladder. J. Am. M. Ass., 1923, lxxx, 1748.

TRUE PROSTATIC CALCULI

Clinical Data Based on Seventy-Six Cases[1]

By HERMAN L. KRETSCHMER, M.D., Chicago

CLINICIANS and contributors to medical literature agree that true prostatic calculi are rare, but this opinion is not based on the scientific data of today. In a previous paper on this subject, a careful review of the literature was made; at that time only 165 cases were found. To this I was able to add 8 personal cases which brought the total number up to 173. Most of the articles and case reports from which the literature was drawn mentioned only single cases with the exception of a paper published by Judd and Crenshaw, in which a series of 20 cases was reported, this being the largest number of cases in any single paper from one source up to that time.

This paper is based upon a series of 76 cases that are or have been under personal observation. It would appear, therefore, that prostatic calculi are not so rare as we have been led to believe. There is no doubt that, with the routine use of the roentgen-ray in urological work which obtains today, an increasing number of cases will be found.

INCIDENCE

The youngest patient in this series was 21 years and the oldest 76 years. Between these two extremes we find the following:

	Cases
20 to 30 years	3
30 to 40 years	11
40 to 50 years	17
50 to 60 years	24
60 to 70 years	15
Over 70 years	6
Not stated	1

The point of significance in this table is that the largest number of cases occurred in the fifth decade.

PREVIOUS ILLNESS

In order to determine whether or not there was an etiological relationship between previous venereal disease and the subsequent development of prostatic calculi, special care was taken in obtaining the histories to seek information upon this point. In this group of 76 cases, 33 gave a history of antecedent gonorrhœal urethritis, 5 stating that they had had more than one attack, of which number 3 admitted having had a third, and one a fourth attack. Hence of the total number of cases, the percentage of antecedent gonorrhœal urethritis was only 43.421. In only 11 cases was a history of stricture obtained. In 5 cases a history of epididymitis was given. A positive history of syphilis was obtained in only 9 cases. In the remaining cases there was no history nor any evidence of venereal disease. It seems reasonable to assume, therefore, that venereal disease plays only a minor part as a causative factor in prostatic stones.

ONSET

The first symptoms or group of symptoms of which patients in this series complained were somewhat variable. This, in part, depends upon the presence of other co-existing pathology, that is, whether or not some other pathological lesion overshadows the prostatic calculi. For example, in several instances the immediate complaint was due to pain and colic caused by stone in the kidney or ureter, and the presence of prostatic stones was ascertained in the course of routine examination.

In a second group of cases the patients were free of all symptoms and all signs of urinary or sexual disease and presented themselves for urological examination prior to entering upon marriage. In another group the patients complained of lesions which are generally attributed to foci of infection, and to the end of ruling out the prostate and seminal vesicles as being etiological factors, it so happened that stones in the prostate were found. In this group were patients who complained of the following: lumbago, sciatica, neuritis, arthritis, and rheumatism. Another group was characterized by the presence of referred pain

[1] Read at the annual meeting of the American Association of Genito-Urinary Surgeons, Virginia Hot Springs, May 10, 11, 12, 1926.

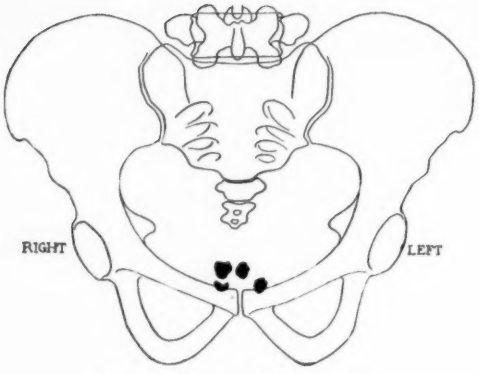


Fig. 1. Presence of four large stones.

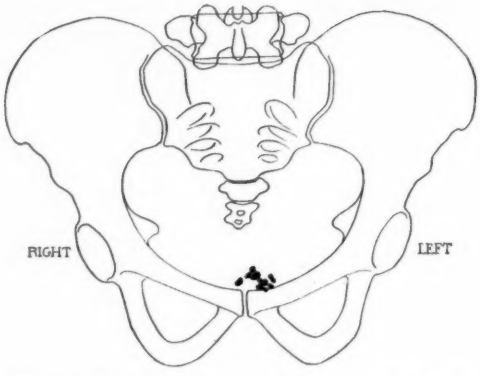


Fig. 2. Multiple stones, most of which are to the left of the median line.

or symptoms, such as pain in the perineum, pain in the sacrum, suprapubic pain, irritation at the neck of the bladder, pain and spasm in the rectum, a full feeling in the rectum—the most frequent referred symptoms being suprapubic and perineal pain. And in still another group the patients had had post-gonorrhœal infections in the prostate and seminal vesicles for which they had been treated routinely by massage, sounds, irrigations, instillations, etc. The shortest duration of symptoms occurred in a case in which they began one day before the patient came under observation; the longest duration was 28 years. In the latter, the chief complaints were burning, hæmaturia, difficulty on urination, and renal colic; this patient also had a very severe chronic prostatitis. Between these two extremes the following duration of symptoms was noted:

	Cases		Cases
1 day	1	1½ years	3
6 days	1	2 years	5
10 days	2	2½ years	1
25 days	1	3 years	6
1 week	3	4 years	4
2 weeks	2	7 years	3
3 weeks	3	8 years	1
4 weeks	3	12 years	1
5 weeks	1	15 years	4
2 months	2	17 years	1
5 months	2	20 years	1
6 months	4	25 years	1
9 months	2	28 years	1
10 months	1	Not stated	6
15 months	2	All his life	1
1 year	6	Since childhood	1

URINARY SYMPTOMS

The group symptoms mentioned most frequently were urinary in character. Urinary symptoms may at times be due as much to the presence of co-existing lesions as to calculi. Indeed, it may be quite difficult at times to state just what part of the symptoms is due to the calculi, and what part to the chronic prostatitis which is so frequently found to be an associated finding. Moreover, these symptoms, considered either singly or in combination, are never pathognomonic; hence a diagnosis based on urinary symptoms alone can rarely if ever be made. Indeed, urinary symptoms were absent in 9 cases, the result being that these patients considered themselves perfectly normal and presented themselves for examination only because they intended to marry.

Of the urinary symptoms, frequency of urination easily heads the list, having been present in 49 of the 76 cases, 64.47 per cent. Nocturia was present in 38 cases, 50 per cent, being a very close second. Burning on urination was present in 28 cases, and this sensation generally occurred during and sometimes after urination and was located in the urethra and around the neck of the bladder. The following table summarizes the urinary symptoms:

	Cases		Cases
Frequency	49	Pyuria	16
Nocturia	38	Urgency	15
Burning	28	Difficulty	15
Hæmaturia	19	Painful urination	19
Dribbling	17	Retention	6

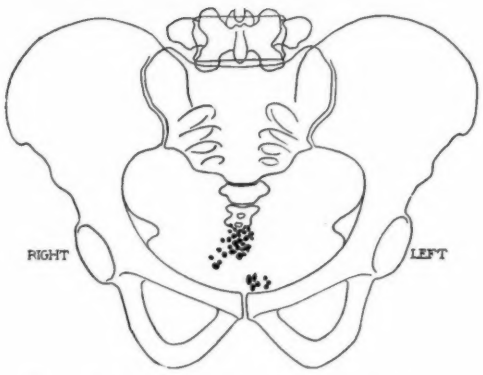


Fig. 3. Small multiple stones arranged in two groups.

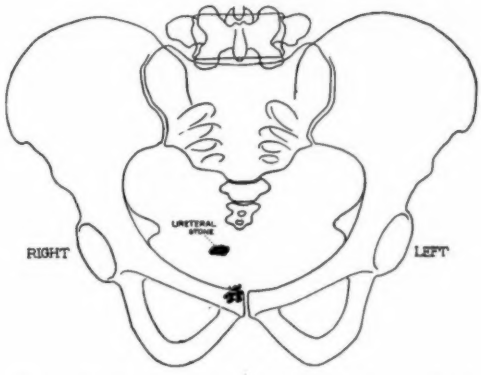


Fig. 4. Small stones in right lobe of prostate associated with stone in the ureter.

SEXUAL SYMPTOMS

The sexual symptoms were much less common and occupy a position subsidiary to the urinary group. The most frequently noted symptom was lack of sexual desire, which was present in patients whose ages varied from 30 to 54 years. Imperfect erections were noted with considerable frequency, and complete impotence occurred in four patients who were 42, 45, 53, and 54 years of age, respectively. Most of the patients, however, were under 45; hence the conclusion must be drawn that the calculi rather than age had something to do with this symptom.

HÆMOSPERMIA

Hæmospermia was noted in only 3 cases, due no doubt to a co-existing infection in the seminal vesicles. While sexual symptoms are of frequent occurrence, they do not dominate the clinical picture nor is there anything about them that is pathognomonic.

URINARY FINDINGS

Careful urinary analysis revealed the presence of some abnormal urinary constituents. In 69 of the 76 cases, in other words, in practically every case urinalysis indicated the presence of a pathological element. Pus was the one element most frequently found, being present in 64 cases, 84.21 per cent. Albumin was found in 26 cases, blood in 26 cases, and sugar in only 2 cases.

Cultures were not made, as a routine, in the early cases; hence certain records were devoid of reports of urinary cultures. However, in the cases in which cultures of the urine were made, the colon bacilli were most frequently found, the staphylococci were next in frequency, and in a few instances both colon bacilli and staphylococci were found together. Streptococci were never found. Today, the making of cultures of the urine is a part of the routine in every clinic; therefore it can be stated in all truth that in the future we may expect very accurate data on this most interesting point.

RECTAL FINDINGS

Careful examination of the prostate *per rectum* showed suspicious changes in a very large number of cases. When the calculi were small and were associated with benign hypertrophy of the prostate, the rectal findings were those of benign hypertrophy. However, in the average case the most striking finding was a change in the consistency of the prostate which, at times, was found to be of extreme hardness so that the condition simulated carcinoma. In several such cases it was impossible to differentiate between stone and carcinoma except by means of the roentgen-ray. On account of the possibility of confusing these two conditions, we have instituted a rule to examine with the X-ray every case in which carcinoma was present or in which

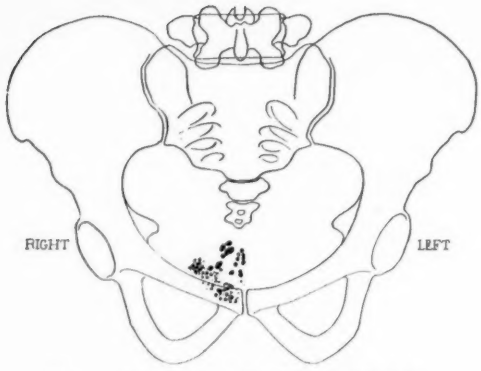


Fig. 5. Multiple stones localized in right lobe.

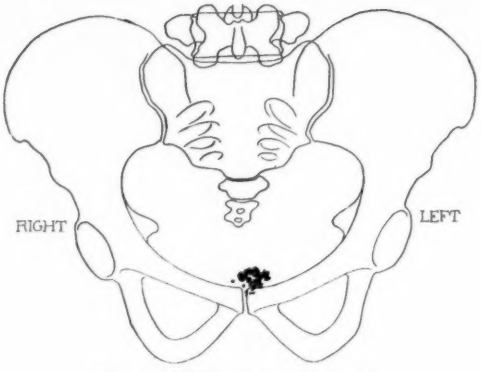


Fig. 6. Multiple stones in left lobe.

carcinoma was suspected. In this series, in several of the cases in which large stones were present, great irregularity of the surface was produced, not unlike that seen in carcinoma of the prostate. In some cases stones could be palpated *per rectum*, which made it possible to make a diagnosis before roentgenograms were taken. The older clinicians and authors have placed considerable emphasis upon crepitation in rectal examination stating that this was a symptom so frequently found that it was pathognomonic. Crepitation was not often present in this series.

Besides the changes in consistency and contour, the prostate was frequently enlarged in a definite manner; in a small group of cases the prostate was not enlarged, the gland being normal in size or even smaller than normal. In the presence of calculi the prostate is nearly always harder than normal, and the normal size in conjunction with the extreme hardness is striking. With an extremely hard prostate of normal size a tentative diagnosis of stone may be made which may be confirmed by a roentgen-ray examination. In only a few cases in this series was the prostate found in a soft and boggy condition.

PRESENCE OF STONES IN OTHER ORGANS

It might be interesting to examine the records in order to determine the frequency with which calculi occur in other parts of the urinary tract synchronously with their appearance in the prostate. In this series of 76 cases stones were present in the urinary tract

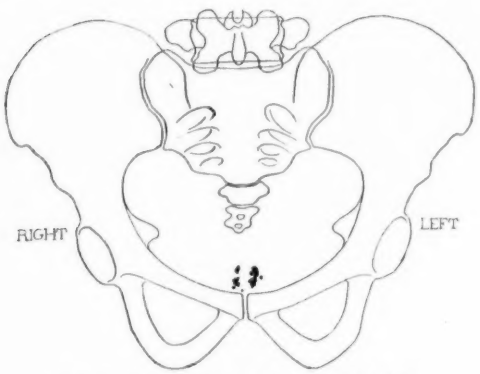


Fig. 7. Shadows in both right and left lobes.

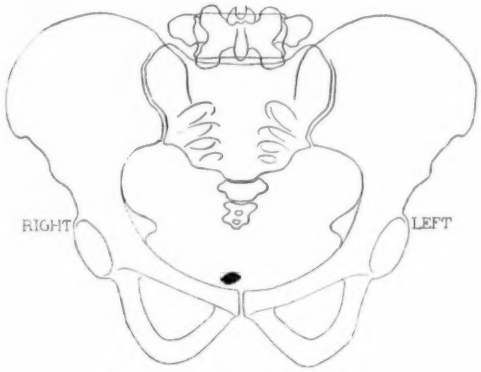


Fig. 8. Solitary stone in right lobe.

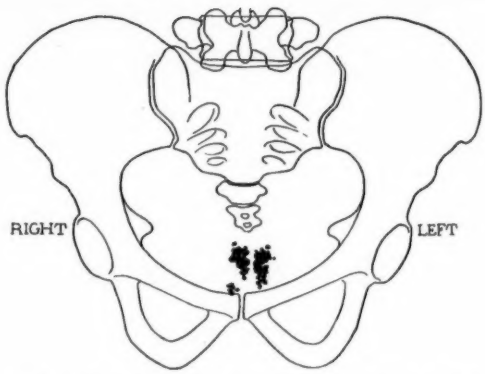


Fig. 9. Two large masses of stones associated with a small group of stones just above the pubic bones.

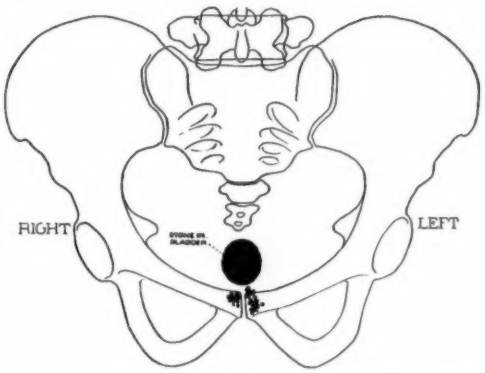


Fig. 10. Large stone in bladder associated with multiple stones in the prostate, the larger collection of stones being in the left lobe. They are seen behind the symphysis.

in 15, the distribution being as follows: kidney, 6 cases; ureter, 6 cases; bladder, 3 cases.

PASSAGE OF CALCULI AFTER MASSAGE

Cases have been reported in which a number of stones were passed in the urine after prostatic massage. Passage of stones following massage was not common in our series, in spite of the fact that some of the patients had been treated by prostatic massage for some time. The removal of the stones by means of the urethroscope is mentioned.

STRIPPINGS FROM THE PROSTATE

Strippings obtained by means of prostatic massage were examined to ascertain the presence of pus as well as bacteria. Unfortunately in some of the earlier cases in this series the records fail to give the desired information.

Pus was present in 34 cases; normal fluid was found in 8 cases; and in 34 cases, examination of strippings was not made or stripping was not done. It is evident, therefore, that calculi may be present in the prostate without the presence of pus in the strippings. On the other hand, in cases showing pus in the strippings with a history of long continued treatment from which the desired relief is not obtained, it is necessary to have roentgenograms made in order to exclude, in case the picture is negative, the presence of stone which might be a factor causing failure of treatment.

ROENTGEN-RAY

The one diagnostic aid that gives us most information is the roentgen-ray. Its routine employment often shows the presence of stones when least suspected. It is my opinion that, if a good film is made with special reference to the prostatic area and the film does not show stones, it would seem reasonable to assume that stone, as a factor in the patient's ailment, may be excluded. The routine use of the roentgen-ray has led to many surprises: stones are recognized which would have been overlooked except for this diagnostic method.

Reasonable care should be exercised in taking the films, thought being given to project the shadows of the stones above the pubis; in several instances we found that the shadows were recognized only after very careful plate reading, as the stone shadows were behind the shadow of the symphysis pubis. In such instances other pictures were made with the films projected in such a way that the stone shadows fell above that of the symphysis. As a rule, the shadows lay on either side of midline, although occasionally they were seen either on the right or left side; hence, shadows may be seen only on one side or they may be located at midline. As a rule the shadows were very small, but at times very large stones were seen. Some difficulty in interpretation may arise when the films show multiple shadows in the bony pelvis, known to be due to lesions outside the urinary tract.

DIFFERENTIAL DIAGNOSIS

The three lesions which most frequently cause confusion in the differential diagnosis are carcinoma, tuberculosis, and chronic prostatitis. As previously mentioned, authorities have stated that carcinoma and stone do not occur in the same patient. Nevertheless, in this series carcinoma and stones were associated in 5 cases. Some difficulty may arise in differentiating stone from carcinoma and, in several cases in this series, it was impossible to achieve this end by means of a rectal examination alone. In these instances, differentiation by means of the roentgen ray has always proved successful.

In several instances, occasion arose in which we were obliged to differentiate between prostatic calculi and calcification due to tuberculosis. As a rule, in such patients, other evidences of tuberculosis were manifest, such as tuberculosis of the epididymis, seminal vesicles, bladder, or kidney, and it was then assumed that the calcification was due to tuberculosis rather than to simple stone.

In certain cases of chronic prostatitis, when the desired relief is not obtained and rectal examination fails to clear up this point, our rule is to examine such cases routinely with roentgen rays to ascertain whether or not stones are present. Furthermore, all cases of chronic prostatitis that give a history of having been under treatment for a long time and still have evidence of pus in the prostate and symptoms referable to that gland, are subjected, for similar reasons, to X-ray examinations.

ASSOCIATED LESIONS

In some of the cases in this series, stones were found during routine physical examination, although no symptoms presented themselves which could be attributed to their presence. In another group of cases, there was evidence of disease in other organs, the importance of which, at times, outdistanced any symptoms due to the presence of stones, and, furthermore, no connection between the two was apparent.

A review of the histories showed the following lesions:

ASSOCIATED LESIONS

	Cases
Lesions of the prostate:	
Stones without other lesions	19
Recurrent stones in the prostate	1
Chronic prostatitis	14
Carcinoma of the prostate	5
Hypertrophy of the prostate	9
Hypertrophy and kidney stone	2
Abscess of the prostate and kidney stone	1
Median bar	1
Median bar and diverticulum	1
Stone in seminal vesicle	1
Lesions of the kidney:	
Chronic nephritis	2
Stone	2
Kidney, bladder and ureter stone	1
Hydronephrosis	1
Pyonephrosis	1
Lesions of the bladder:	
Carcinoma	1
Papilloma	1
Stone	1
Lesions of the urethra:	
Stone	3
Stricture	7
Periurethral abscess	1
Miscellaneous lesions:	
Arthritis	2
Spinal syphilis	1

SUMMARY

1. Stones in the prostate occur more frequently than is generally believed.

2. They may be present without causing any characteristic symptoms.

3. Not infrequently they are associated with other lesions of the urinary tract, the symptoms of which overshadow those of prostatic calculi.

4. The fact that they are liable to occur in chronic prostatitis may account for the presence of pus in the strippings and may be the reason that routine treatment fails.

5. They are often associated with more serious diseases such as benign hypertrophy and carcinoma.

REFERENCES

HUBENY, M. L. Am. J. Roentgenol., 1919, vi, No. 6, 286–289.

JUDD AND CRENSHAW. Minnesota Med., 1919, ii, 52–56.

KRETSCHMER, H. L. Surg., Gynec. & Obst., 1918, xxvi, 70–76.

BENIGN ADENOMA OF THE KIDNEY

Report of a Case[1]

By E. STARR JUDD, M.D., F.A.C.S., Rochester, Minnesota

and

HAROLD E. SIMON, M.D., Rochester, Minnesota
Fellow in Surgery, The Mayo Foundation

BENIGN adenomata of the kidney may grow to such a size as to produce rather severe clinical symptoms. There is considerable satisfaction in removing a huge renal mass of a benign type because surgical operations on the kidney for neoplasms are limited almost exclusively to the malignant type of tumor. The following case is, therefore, of interest.

A woman, aged 51 years, came to the Mayo Clinic March 8, 1926, complaining of intermittent attacks of pain and hæmaturia, present for the last 11 years. The attacks were characterized by severe pain in the right lumbar region, radiating down the right thigh, and followed by hæmaturia, at times fairly severe. At first the attacks had come at intervals of from 2 to 3 months, but recently had become more frequent. For several years the patient had been aware of a mass in the right side of the abdomen, but it had recently increased in size. During this time her general health had been good and she had gained in weight.

She was fairly well nourished and weighed 135 pounds. A large, somewhat irregular mass extended from the right costal margin down to the crest of the ileum and across to the median line of the abdomen. It was slightly movable and moderately tender in some areas. Otherwise the patient was essentially normal. The systolic blood pressure was 170, and the diastolic 100; the pulse rate was 112. Urinalysis showed nothing of note except a few pus cells. The hæmoglobin was 75 per cent; the erythrocytes numbered 4,420,000, and the leucocytes 5,900. The blood Wassermann reaction was negative. The blood urea was 22 milligrams for each 100 cubic centimeters of blood. The combined phenolsulphonephthalein test gave a return of 50 per cent in 2 hours. Roentgenograms of the kidneys, ureters, and bladder were made. A shadow was visible in the right side of the abdomen, opposite the third lumbar vertebra.

The cystoscopic examination revealed a normal bladder. Clear spurts of urine were seen coming from both ureteral orifices. Ureteral catheters were passed without difficulty; the differential phenolsulphonephthalein test yielded about one-third the normal return from the right side, and a normal return from the left. The pyelogram of the right pelvis showed a rather indistinct outline; the calyces were elongated and there was a longitudinal filling defect. The right ureter was tortuous and dilated in the upper third (Fig. 1). The left pyelogram was negative.

A diagnosis was made of right renal tumor, and exploration was advised. March 31, the kidney was exposed through a right lumbar incision. A huge tumor was found, arising from the kidney and intimately associated with it in such a manner that there was considerable encroachment on the pelvis. The tumor appeared to be confined within its capsule, and the renal veins, although dilated, were thin walled and collapsible. Nephrectomy was performed. The convalescence was uneventful and the patient was up and about by the thirteenth day.

The kidney was slightly atrophic in appearance. The tumor, 13 by 11 by 5 centimeters, occupied one pole and the mesial border of the kidney. Its surface was nodular and covered by a thin pearl gray capsule. On section (Fig. 2) the tissue was yellowish-gray and the tumor was sharply demarcated from the renal tissue, although no capsule was visible on this side. It was of fairly uniform consistency and appearance throughout except for the presence of a few scattered hæmorrhagic areas and several trabeculæ of connective tissue, which produced a lobulated appearance. Careful examination of the attached perirenal tissues failed to show any gross evidence of metastasis or extension beyond the limits of the tumor.

Microscopically there was a moderate increase in the interstitial tissue and rather marked lymphocytic infiltration of the renal parenchyma, especially in the areas adjacent to the tumor. Bowman's capsules were moderately thickened and many hyalinized glomeruli were present. Surrounding the tumor was a definite zone of compressed renal tissue (Fig. 3) in which were numerous thick walled vascular channels. Here and there, dense bands of connective tissue, apparently perivascular in origin, formed a fragmentary cap-

[1] Submitted for publication June 21, 1926.

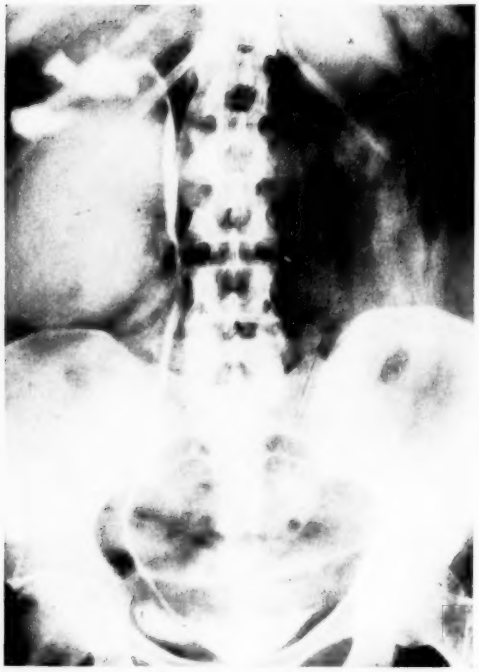


Fig. 1. Pyelogram of kidney with large adenoma. Large shadow in the left renal area. There is elongation of the calyces with a longitudinal filling defect, and the ureter is tortuous and dilated in the upper third.

sule for the tumor on the renal side, while the surface peripheral to the kidney was bounded by a thin but continuous fibrous capsule. The tumor tissue consisted of papillary and tubular structures (Figs. 4 and 5) in approximately equal proportions. The tubules were similar to those of renal tissue, being formed of cuboidal or low columnar cells with granular protoplasm, a large nucleus and a definite nucleolus, uniformly arranged on a basement membrane. Mitotic figures were rare and very little fat was present in any of the cells. These tubules were uniform in type and were separated by very little connective tissue. In other areas the cells were similar in character and appearance but they were arranged on papillary projections of connective tissue.

REVIEW OF THE LITERATURE

Bell and Johnston reported the case of a woman, aged 39 years, with a history of

Fig. 2. Cross section of large adenoma (b), with a portion of the kidney (a) in which it originated.

hæmaturia and of a renal tumor which had been noted for 5 years. Nephrectomy was performed and the tumor appeared as a large, irregular, nodular mass, 13 by 10 by 7.5 centimeters, weighing 650 grams. The patient died 16 hours after operation. The tumor was separated from the renal substance by a thin fibrous capsule, and there was no evidence of metastasis. Histologically it was composed of small and large alveoli, the latter having lumina.

Keyes reported the case of a man in which nephrectomy had been performed. Hæmaturia, accompanied by loss of strength, had persisted for many weeks. The kidney had been almost entirely replaced by a nodular adenoma composed of papillary structures, with some alveoli. The tumor varied throughout in the proportion of connective tissue, in vascularity, and in the type and degree of degeneration present.

Kynoch reported a case of nephrectomy in a child 16 months of age. A tumor, approximately 5 by 5 by 6.5 centimeters, was found growing from the posterior portion of the kidney. Histologically it proved to be an adenoma consisting of alveoli lined with columnar epithelium. Rather a large proportion of fibrous tissue was present in this tumor.

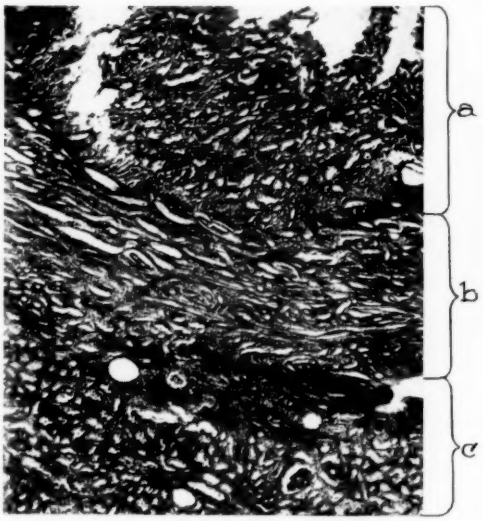


Fig. 3. Photomicrograph of the adenoma (a) surrounded by a zone of compressed renal tissue (b); lymphocytic infiltration and increase in connective tissue in the renal parenchyma (c). (× 30.)

Morris reported 3 cases. The first was that of a man, aged 48, who had had intermittent hæmaturia for 8 months. At operation a large, encapsulated renal tumor was found, which microscopically had the appearance of a simple adenoma, papillary and tubular in structure. His second case was that of a woman, aged 46, who had had some pain in the right side but no urinary symptoms. At exploration an encapsulated tumor was found in the lower pole of the right kidney, and nephrectomy was performed. Histologically it consisted of epithelium of renal type, arranged in the form of tubules, and without any evidence of malignancy. His third case was similar to the second, but the tumor was subcortical and was not found until necropsy was performed.

Foulds, Scholl, and Braasch reported one adenoma in a series of 283 cases of tumor of the kidney in which operation was performed at the Mayo Clinic from January 1, 1901, to January 1, 1923. The patient was a woman, aged 48, who had suddenly developed severe hæmaturia. At operation the left kidney was found to contain a huge encapsulated tumor, 12 centimeters in diameter. Histologically it

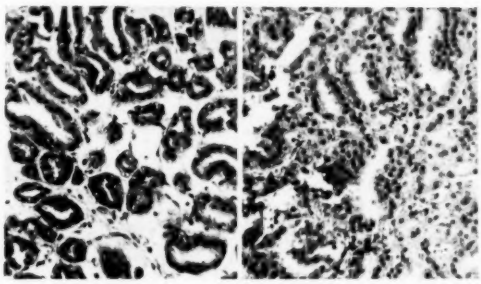


Fig. 4 (left). Photomicrograph of the adenoma showing uniform tubular structures with basement membrane and scant interstitial tissue. (× 120.)

Fig. 5. Photomicrograph of the adenoma showing both papillary and tubular structures. (× 120.)

was a benign adenoma. The patient was well 9 years later.

PATHOLOGY

Small benign adenomata of the kidney are not of uncommon occurrence at the necropsy table. There they are found varying in size from a few millimeters to 3 or 4 centimeters in diameter. They are quite frequently multiple and may occur in one or both kidneys in the same person. Tumors of this size and type, even when multiple, produce no clinical symptoms. Rarely, as we have seen, they become of such size that fairly severe symptoms develop.

Histologically, the small and the large tumors are similar and occur in three types. The papillary type is the most common and is found in its purest and most elementary form in the smaller tumors. This type of structure also predominates in the larger tumors but in these is usually combined with one or both of the other types. Difference in the actual and relative length and breadth, in the number and compactness of the papillary formations, as well as in the type of cells covering them, are responsible for a variety of appearances, even when the structure remains fundamentally papillary.

The second is the tubular or canalicular type; its occurrence is next in frequency to the papillary type. While the tubules differ in appearance and character in the different tumors, they are of fairly uniform appearance in any given case. The connective tissue sep-

arating them is usually scant and glomeruli are not found.

The third type is designated by Albarran as the alveolar adenoma with clear cells. It is composed of lobules of alveoli whose cells often have a high fat content, giving them a vesicular appearance. However, this characteristic is not limited to this type alone as the cells of the other types often have a high fat content and clear protoplasm.

There can be little doubt that these tumors arise from the renal parenchyma. Their relationship to the malignant tumors has not been definitely established, but it is quite possible that they may become malignant.

DISCUSSION

The benign nature of the tumor in the present case seems definitely established. It was undoubtedly of more than 11 years' standing because symptoms had been present for that length of time, and benign tumors are, as a rule, incapable of producing symptoms until they become quite large. If the rate of growth prior to the onset of symptoms was the same as that of the later period, it is fair to assume that it was at least several years older than the symptoms would indicate. In spite of its long duration and its size, there had been practically no effect on the patient's general health, and she had even been gaining in weight during that time. Grossly there was no evidence of involvement of the perirenal tissue or of invasion of the vessels, both of which one would expect to find in a tumor of this age and size, were it of a malignant character. Microscopically there was no evidence of extension of the growth beyond the capsule; the arrangement was regular throughout and the cells did not show any malignant characteristics.

Pre-operative differentiation from malignant tumors is, of course, impossible. There are no roentgenological data, according to Braasch and Carman, that are of value in differentiating the two. An unusually long history, with little evidence of general disability, in a patient with a renal tumor, should suggest the possibility of a benign neoplasm; but other than this one must rely entirely on the pathological examination for a diagnosis.

The treatment practically always consists of nephrectomy, because by the time clinical symptoms occur with sufficient severity to necessitate operation, the tumor has become of such a size that enucleation is not possible.

BIBLIOGRAPHY

1. Albarran, J., and Imbert, L. Les tumeurs du rein. Paris: Masson et Cie., 1903, 17–28.
2. Bell, J., and Johnston, W. G. A rare form of kidney tumor. Montreal M. J., 1891, xix, 561–575.
3. Braasch, W. F., and Carman, R. D. The pyelographic and roentgenologic diagnosis of renal tumors. Radiology, 1925, iv, 445–452.
4. Foulds, G. S., Scholl, A. J., and Braasch, W. F. A study of histology and mortality in renal tumors. Surg. Clin. N. Am., 1924, iv, 407–424.
5. Keyes, E. L. Adenoma of the kidney; successful nephrectomy. Am. J. M. Sc., 1890, c, pt. 2, 549–558.
6. Kynoch, J. A. C. Tumour of right kidney in a child. Lancet, 1897, i, 246.
7. Morris, Sir Henry. Renal adenomata. Practitioner, 1911, ii, 1–7.

ADAMANTINE EPITHELIOMA[1]

By WARNER S. BUMP, M.D., Chicago
Assistant Attending Surgeon to St. Luke's Hospital

ADAMANTINE epithelioma is the term suggested by Malassez (36 and 23) for certain tumors of the jaws, solid or cystic with a fibrous tissue matrix, which grow within alveolar borders, distend the maxilla, and sometimes break through the bony capsule into the maxillary sinus, orbit, or even into the cranial cavity; but which do not spread by metastasis. Commonly these tumors are known as adamantinomata. However, as Galippe (23) says, adamantinoma etymologically indicates a growth made up of enamel, rather than one derived from enamel-forming tissue, as in the case reported.

In 1877 Kolaczek (30) and in 1881 Buchtemann (12) described tumors, which evidently were adamantine in nature, but they did not connect them with the enamel organ. Other tumors, probably adamantine epitheliomata, were described still earlier without their true significance being recognized. Falkson (19) in his description of one of these tumors in 1879 was the first to see a resemblance in its structure to that of the enamel organ. Malassez (36) in 1885 published a report of his studies of tumors of the jaws and presented his belief that most of the tumors, peculiar to the jaws, had their origin in paradental epithelial débris. Early reports of adamantine epitheliomata were made by Bryck (11), Eve (17), Bernays (6), Albarran (1), Pincus (49) Hildebrand (27), Nasse (44), Kruse (32), Derujinski (16), Souligoux and Pilliet (53), Forgue (21), Becker (4), Boularan (10), Chibret (14), Massin (37), Nové-Josserand and Berard (46), Wiemann (56), Bennecke (5), Prym (50), Lérard (34), Matsuoka (38), and others; so that Steensland (54) in 1905 was able to collect 21 reports from the literature. Lewis (35) in 1910 described three polycystic adamantine epitheliomata and found 70 on record. Since his report, Stumph (55), Kuru (33), Krompecher (31), New (45), Wohl (58), Graves (24), Muller (42), Carnathan (13), Schlosser (52), Winter (57), Horsely (28), and a few others have added reports; and Murphy (43), describing a case in 1924, states that about one hundred are now on record. The Morlets (41) in 1925 made another addition to the list.

In spite of the relatively small number of these tumors reported, numerous workers have studied and written of them. While there have been various theories devised to explain the formation of adamantine epitheliomata, such as the follicular dilatation theory of Broca, or the theory of Buchtemann, assuming in-growths of gingival epithelium; Malassez's explanation of the origin of these tumors is accredited as the most satisfactory. He believed that the atrophied, isolated groups of epithelial cells about the roots of teeth, under certain conditions, proliferated and gave rise to tumors which resembled the structures from which the débris was derived. Those tumors, which resembled the enamel organ, were called adamantine epitheliomata. They vary greatly in structure, but in order to be classified as adamantine epitheliomata, they must contain cell-groups which resemble those present in some stage of development of the enamel organ. Because of this resemblance a knowledge of the transient epithelial structures normally present during the development of the teeth and of their more permanent débris, is the basis for the recognition and understanding of these tumors.

The publications in English contain various reports of adamantine epitheliomata, usually with résumés of the literature. The most recent of these (Murphy, 43) has an almost complete bibliography. However, little more than mention of the basic work of Malassez and Galippe is found therein.

It is the purpose of this study to review briefly the excellent and important work of Malassez and Galippe, and to report two cases of adamantine epitheliomata.

THE EPITHELIUM OF DENTITION AND ITS DÉBRIS

In Galippe's (23) monograph there is an excellent description of the development of

[1] From the Henry Baird Favill Laboratory of St. Luke's Hospital.

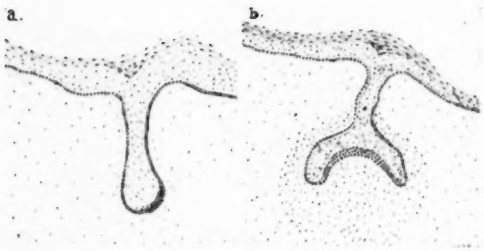


Fig. 1. a. Infolding of the gingival epithelium in a fetus of 2 months, forming the dental ridge. *b*, Pedunculation, forming the enamel organ. The proliferated connective tissue has pushed up into the enamel organ giving the latter the appearance of a two-layered cup and itself forming the dental bulb.[1]

the teeth and of the formation of the paradental epithelial débris. Figures 1 to 5 are modified from those of Galippe. They briefly trace the stages in tooth development and illustrate the different epithelial structures, which, after serving their purpose, become only débris.

The epithelium, taking part in tooth-formation, may be compared to a gland (Galippe, 23), with the enamel the secretory product. The "gland" is formed by an infolding of the buccal epithelium along the line, which later is to be the gum (Fig. 1). Then, at intervals along this epithelial ridge buds form, which become pedunculated; the bud proper becoming the young enamel organ and the pedicle its cordon (Figs. 1 and 2). Vegetations grow from the gingival epithelium, dental ridge, and from the cordon and superior part of the enamel organ, evidence of the great proliferative activity of the epithelium. The structure of the dental ridge and cordon closely resembles that of the buccal lining at the site of infolding. It consists of peripheries of cuboidal cells with a middle mass of polyhedral cells with intercellular bridges, and here and there an epidermal globe (inclusions of the superficial flattened cell layer of the gum epithelium). The cells of the enamel organ, however, become specialized, as do those of the gland-acinus. The peripheral cells become cylindrical and the central cells become star-shaped (Fig. 3). The neighboring connective tissue, stimulated by the epithelial growth, also

[1] Figures 1 to 5 are modified reproductions from Malassez and Galippe.

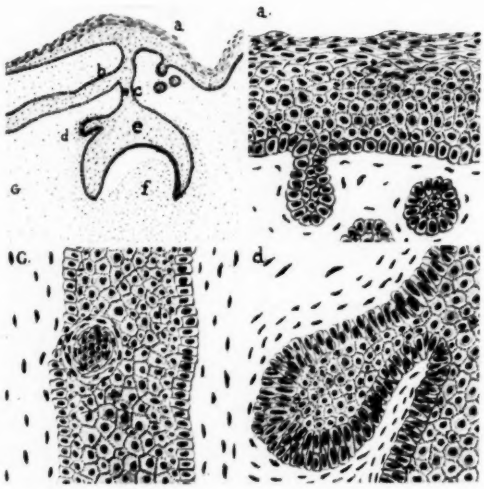


Fig. 2. Dental organ of a fetus of 4 months. *a*, Gingival epithelium with vegetations from its deep surface. *b*, Dental ridge. *c*, Cordon of enamel organ with an epidermal globe (inclusion of flattened cell layer of gingival epithelium). *d*, Vegetation from the external layer of the superior part of the enamel organ. *e*, Enamel organ. *f*, Dental bulb. *g*, Connective tissue of gum.

proliferates and then pushes into the globe-like enamel organ from below, forming the dental bulb, and giving the adamantine organ the appearance of a two-layered cup. The cells of the dental bulb, nearest the epithelium, become specialized and gradually form the dentin. Only the internal layer of the enamel organ is necessary for the deposition of enamel upon the dentin. Therefore, all of the remaining epithelium atrophies.

In view of such extensive and intense epithelial proliferation, it is, indeed, striking that the enamel is the only part of the adult tooth which is of epithelial origin. In animals, which have numerous dentitions, the epithelial cells remain, forming new teeth as they are needed. In man, however, after the enamel is formed, the cells, themselves, atrophy and become dissociated.

It is hardly to be expected, after such extensive epithelial proliferation, that all of the epithelial cells should entirely disappear. And it is true that all of these cells do not disappear, for Malassez (36 and 23) has demonstrated remnants of them: in the gum of

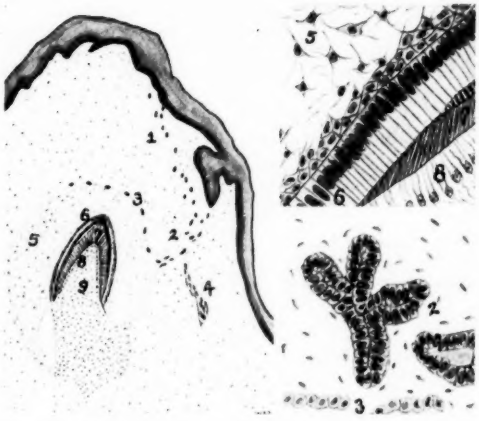


Fig. 3. Dental organ in a fetus of 5 months. *1*, Superficial epithelial débris derived from the gingival epithelium. *2*, Middle débris from cordon. *3*, Deep débris from external layer of enamel organ. *4*, Cordon bud for permanent tooth. *5*, Pulp of enamel organ (star-shaped cells). *6*, Internal layer of enamel organ (enameloblasts). *7*, Dentin. *8*, Dentinoblasts. *9*, Dental pulp. The enamel is between *6* and *7*.

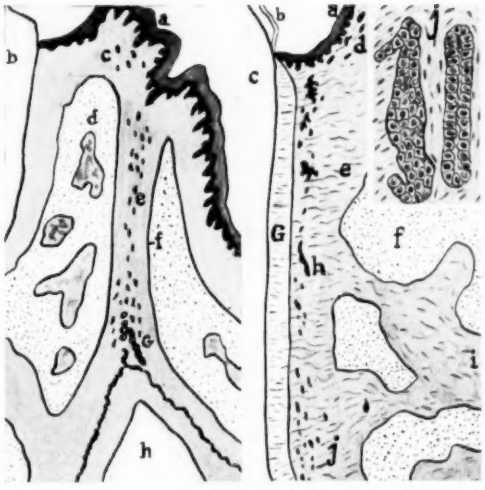


Fig. 4 (left). Gubernacular débris in infant of 3 years. *a*, Gingival epithelium. *b*, Temporary tooth. *c*, Gingival or superficial débris. *d*, Maxilla with medullary cavity. *e*, Middle débris from cordon and dental ridge. *f*, Gubernaculum dentis. *g*, Deep débris from cordon and superior part of enamel organ. *h*, Crown of permanent tooth. The gubernacular débris proliferates to form cysts which act as excretory duct for the tooth.

Fig. 5. Composite of five consecutive sections through region of adult premolar. *a*, Gingival epithelium. *b*, Cuticle of enamel. *c*, Premolar tooth. *d*, Superficial débris. *e*, Alveolar-dental ligament. *f*, Maxilla. *g*, Cement. *h*, Radicular débris (middle). *i*, Medullary cavity. *j*, Deep débris from enamel organ in form of cords of atrophied cells or tubule-like structures.

the fetus and infant between the gingival epithelium and the series of adamantine organs (Fig. 3), in the gubernaculum of the unerupted tooth of the child (Fig. 4), and about the roots of teeth in the adult (Fig. 5).

It is plausible that continued trauma or infection may stimulate this dormant débris to new growth; and it is not unlikely that the type of tumor formed depends upon the origin of the proliferating débris, as well as upon the degree of differentiation of the cells. If the characterless cells of the epithelial débris merely proliferate and hypertrophy, a carcinoma-like tumor may result. If the cells also undergo differentiation, tumors may result, the epithelial masses of which resemble in varying degrees, structures which are normally present in tooth-development.

If the more superficial débris proliferates and differentiates, the resulting tumor may contain flattened cells, cuboidal cells, or polyhedral cells with or without intercellular bridges, or all of these. These cells may be arranged in masses, as in the gum of the fetus or infant, or they may form tubule-like structures as in the gubernaculum. These tubule-like structures may dilate to form cysts, as they normally do in the gubernaculum in forming the "excretory duct" for the erupting tooth. The lining of the cysts may be of flattened cells, of stratified squamous epithelium, or of cuboidal cells.

If the deeper débris proliferates and differentiates, the resulting tumor may contain cylindrical cells (enameloblasts), or star-cells, and more rarely enamel and even dentin and cement.

As the connective tissue is normally stimulated by the proliferating epithelium; it is, therefore, found in varying amounts in adamantine tumors, acting as a stroma for the epithelium. In some tumors the stroma comes to overshadow the epithelium, resulting in a sarcoma-like neoplasm.

In a single tumor, the epithelium may be composed entirely of one of these types, or it may be of all types, one or the other type preponderating.

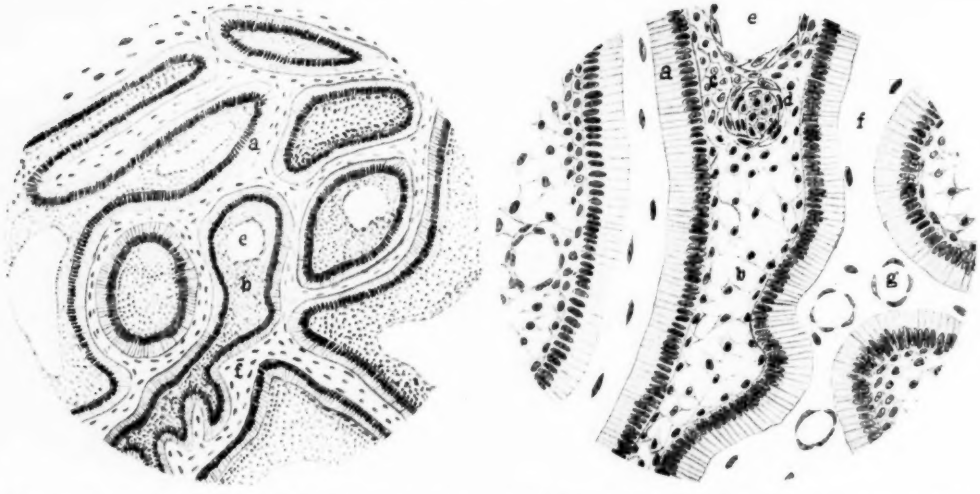


Fig. 6. Tumor of Case 1. *a*, Peripheral layer of cylindrical cells. *b*, Star-shaped cells. *c*, Polyhedral cells. *d*, Epidermal globe. *e*, Small cyst. *f*, Stroma. *g*, Blood vessels.

CASE REPORTS

CASE 1. Mr. T. W., age 58 years, entered St. Luke's Hospital on May 17, 1922, on the service of Dr. Wm. Harsha. He had a painless swelling of the right side of the upper jaw about one-half the size of a lemon. In the mouth along the gum for 3 centimeters from the posterior extremity of the upper right maxilla was a dark red, cauliflower-like mass which bled easily. The teeth in this region were loose.

The tumor was noticed 8 years before entrance, following the appearance of a purulent discharge from "a back tooth of the upper right jaw." During the latter half of this time, the tumor had grown more rapidly. Thirty pounds in weight were lost during the last one and one-half years. There was a definite history of syphilis and a positive Wassermann reaction.

On May 18, 1922, Dr. Harsha removed the tooth anterior to the tumor. Most of the superior maxilla (4 by 2.5 by 2.5 centimeters) was practically free and surrounded by tumor tissue. The latter had no apparent cysts and extended to the floor of the orbit of the right eye. After thorough removal of the free bone and tumor tissue, the wall of the cavity was cauterized with the electrocautery and a gauze pack inserted.

Much of the tissue, removed at the operation, consists of irregular masses of epithelium, supported by a thin connective tissue framework (Fig. 6). The connective tissue makes up only about 5 to 10 per cent, merely forming thin partitions between the many epithelial masses. The epithelial groups vary in shape. Some are more bulb-like, in the sections resembling the young enamel organ. The external portion of these masses is a single layer of high columnar epithelium with the nuclei away from the stroma (Fig. 6). The more central cells, surrounded by this enameloblast-like layer, vary in shape. Some are polyhedral, some are similar to these but more flattened; and many, especially the more central ones, are, in varying degrees, star-shaped with thread-like processes extending from the points. The high columnar cells are like the enameloblasts, and the star-shaped cells like the cells of the pulp of the enamel organ (compare Figs. 3 and 6).

In places there are small groups of polyhedral cells, surrounded by the more flattened cells, arranged concentrically. And in a very few places some of the central polyhedral cells have intercellular bridges (Fig. 6). These groups resemble the more superficial structures in early tooth development (Fig. 2).

Some of the epithelial masses are vacuolated forming very small cysts, lined by the flattened cells. In places, the columnar cells are closely packed with their nuclei at different distances from the cell-bases, giving a pseudo-stratified appearance. And in other places this external portion is truly formed of more than one layer of cells, which are shorter or cuboidal in type. In one region the connective tissue is in greater abundance than the epithelial (3 to 1), and that nearest the epithelial masses is hyaline.

On August 17, 1925 the patient returned to the hospital with a recurrence of about one-third the size of the original tumor. The tissue again was removed with the curette and the cavity wall cauterized with the electric cautery. Gauze packing,

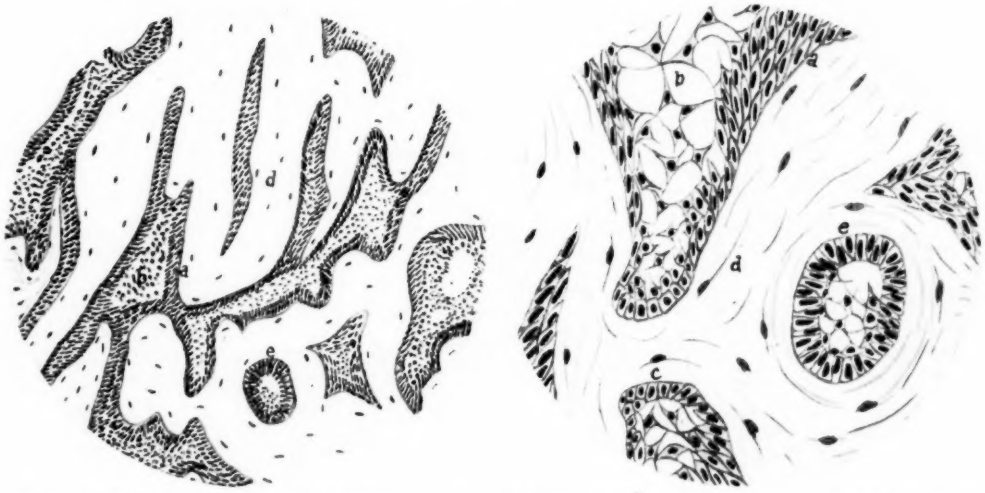


Fig. 7. Sections of the tumor removed in Case 2. *a*, Peripheral layer of flattened cells. *b*, Star-shaped cells. *c*, Peripheral cuboidal cells. *d*, Stroma. *e*, Peripheral pseudo-stratified layer.

saturated with 25 per cent zinc chloride, was inserted.

The tumor tissue is essentially like that removed at the first operation, except that the epithelial portion is increased at the expense of the connective tissue, and the latter is more hyaline.

Case 2. Mrs. M. C., white, age 25, entered St. Luke's Hospital on November 30, 1925 to the service of Dr. H. A. Potts. She had a swelling in the region of the angle of the mandible on the left side which extended cephalad in the ascending ramus. It was not tender on deep pressure, but at times was spontaneously painful. The left, lower, third molar was absent, and at its site was a sinus 2 by 6 millimeters. The tissues of the cheek above the ascending ramus of the mandible were œdematous. X-ray plates indicated a cystic tumor, expanding the left half of the mandible, especially the ascending ramus.

Two and one-half years before, she had noticed a somewhat painful swelling of the left submandibular region which became worse in 5 months. A dentist removed an impacted, left, lower, third, molar tooth. However, the swelling continued and from the socket of the tooth, a fœtid, serous fluid was discharged. Five months before entrance a surgeon made a diagnosis of osteomyelitis and "scraped the bone," after which the swelling became greater.

The lower, left, second molar was removed by Dr. Potts on December 4, 1925. The tumor extended from here posteriorly to the angle of the mandible, and then cephalad in the ascending ramus almost to the temporo-mandibular joint. It was apparently a large cyst with a thick wall of gray tissue, covered by a very thin shell of bone and filled with purulent fluid. The soft, gray tissue, in all about 10 cubic centimeters, was removed with the curette, and the cavity was packed with iodoform gauze.

This tissue consists chiefly of large masses of epithelial cells with practically no connective tissue. Where the cells are loosely arranged, they have the typical star-shape of the pulp-cells of the young enamel organ. Where they are more compact, they are flattened or even spindle-shaped, resembling the intermediate layer of the young enamel organ. In places about blood vessels, the cells are thicker, more polyhedral, or even cuboidal in shape.

In some sections there are regions where there is considerable connective tissue stroma (Fig. 7). Here the epithelial portions are distinct cords or thicker, elongated masses, surrounded by fibrous connective tissue, which forms about 60 per cent of the total tissue. The thinner cords are formed of masses of flattened cells with elongated nuclei. The larger masses have a pulp of star-shaped cells and a more compact periphery, varying in thickness from one to several layers of cells. The cells adjacent to the pulp are polyhedral, blending with the star-cells. Those at the periphery are, for the most part, flattened, arranged diagonally, so that an angle is made to the edge of the mass by the long axis of the cells. In a few places, however, cuboidal cells are at the periphery. A few, more rounded, epithelial masses are found, like the cords and elongated masses, except that the peripheral layer is the pseudo stratified type (Fig. 7).

This tumor less closely resembles any normal structure in tooth development. The star-cells, however, typically belong to the enamel organ. The peripheries of the epithelial masses, especially where they have the pseudo-stratified appearance,

recall the structure of the very young enamel organ particularly in the region where the vegetations grow from it (Fig. 2).

The tumor described by Chibret (14) was remarkable, for it contained almost all of the cell-groups, which are found in adamantine tumors. There were masses of character-less cells resembling carcinoma and probably representing hyperplasia of the epithelial débris without differentiation. There were small cysts, like those in the gubernaculum dentis, and masses of star-shaped and cylindrical cells, closely resembling the enamel organ, even to the presence of enamel. Part of the tumor was of connective tissue, in varying degrees of development, with regions of dentin and cement-formation. Dentin was also contained in one of the tumors reported by Wohl (58).

Perier's (47) tumor had tubules, cysts, and cell-masses, much like the enamel organ. That reported by Graves (24) had typical cylindrical cells and also flattened cells in concentric arrangement, resembling epithelial pearls, or the epidermal globes, found in the dental ridge and cordon of the fetus, and later in the superficial epithelial débris. St. Germain's (51) tumor was solid and contained much fibrous tissue, star-shaped and flattened cells, but no cylindrical ones. One of Albarran's (1) tumors, likewise, was solid and contained polyhedral, flattened and star-shaped cells, but none cylindrical. Another of his had epithelial groups and cysts, like those in the gubernaculum. Hildebrand's (27) had dendritically branching twigs of epithelium and also structures, representing teeth in all stages of development. In Steensland's (54) summary of 21 adamantine epitheliomata, only 4 were solid. The first of the 2 tumors reported here should probably be classified as solid, for it contains only microscopic vacuoles in the centers of the small epithelial masses.

Adamantine epitheliomata with only very small cysts are reported by Nasse (44), Kruse (32), Nové-Josserand and Berard (46), Wiemann (56), Prym (50), Ferrero (20), and Morestin (40). Most of the reported adamantine tumors were grossly cystic, containing serous, mucoid, or fatty fluid, with or without lime or cholesterin particles. Kruse (32) describes 3 tumors: one with dendritically branching twigs of epithelial cells, resembling the structure of the dental ridge; another with small cysts and masses of cells with a tendency toward a peripheral layer of cylindrical cells; and a third with conspicuous cysts. He believes that these 3 tumors represent the stages in the transformation of solid adamantine epitheliomata to the grossly cystic type. Muller's (42) tumor contained 6 cysts, lined by stratified squamous epithelium.

The first and more solid tumor, in this report, was in the upper jaw, where, according to Pincus (49), the more solid type is usually found. The second tumor was markedly altered by infection, so that a cystic cavity, containing purulent fluid, was formed. The lining of this cavity was of tumor tissue, rather than a definite epithelial layer.

Lewis (35) and Carnathan (13) report adamantine epitheliomata which were first diagnosed as sarcomata. These tumors may have the appearance of a sarcoma due to preponderance of young connective tissue or to a very compact arrangement of epithelial cells. In the latter case, the usual polyhedral or star-shaped cells are compressed, so that they become spindle-shaped.

The size of adamantine epitheliomata varies greatly, depending upon the type of tumor and upon the length of time, during which growth is allowed. The more solid tumors grow most rapidly. The cystic type grows slowly and often is allowed to attain great size before it is removed. The tumor, reported by Graves (24), was only 15 by 25 millimeters. That of the first case, reported here, was the size of a lemon; that of Audry (2), the size of an orange; and that of Chibret (14), as large as the head of a full term fetus. Ewing (18) saw one, which grew to the size of a child's head, causing dysphagia and exophthalmos.

In 1905 Steensland (54) summarized 15 reports of these growths.[1] Bloodgood (7) reported 12 cases in 1904. With the addition of data from the records of 20 later observers[2]

[1] Albarran, Becker, Bennecke, Borst, Chibret, Dorujinski, Malassez, Nasse, Prym, Hildebrand, Kruse, Hammer, Hassler, and Monguidi.

[2] Cignozzi, Perthes, Fritsch, Ferrero, Morestin, Kinoshita, Boidin and Delval, Bakay, Lewis, Stumph, Kuru, Krompecher, New, Wohl, Graves, Carnathan, Winter, Muller, Murphy, and the Morlets.

and from the two cases reported here, the following table is made:

	Cases
Male	23
Female	32
Upper jaw	14
Lower jaw	53
Both jaws	2
	Years
Oldest patient	75
Youngest	8
Average age at which tumor began (58 cases)	35.5
Average period of growth before operation (24) cases.	5.4

Massin (37) reports an adamantine epithelioma in a newborn infant. Lewis (35) states that the average period between the appearance of the tumor and operation in 70 cases was 8.5 years.

Malassez (36) thought that disease of a tooth or of the tissue about the teeth was usually the factor inciting the epithelial débris to proliferation. In some cases absence of teeth at the tumor site bears witness of past disease. Few reports of adamantine epitheliomata state the presence or lack of disease preceding the appearance of the tumor. However, impaction of a tooth was mentioned by New (45, in 2 cases), the Morlets (41), Muller (42), and Wohl (58). There was an impacted third molar in one of the 2 cases of this report. An abscess preceded the appearance of the tumor in 3 patients of Steensland's (54) summary, and in one of the cases reported here. In a case recorded by Lewis (35) the tumor followed the removal of a carious tooth, and in Chibret's (14) patient it followed the extraction of an apparently normal one. Perier (47) and Graves (24) state that no teeth were present at the tumor site in the patients reported by them.

Metastasis by an adamantine epithelioma has never been reported, except by Ewing (18), who states that he saw a small metastasis to the lung and cervical lymph node in the case of an "extensive fibro-epithelial tumor," and that in another "very malignant case" the fourth recurrence was in the cervical lymph nodes and loose tissues of the neck. Ewing, however, makes no reference to descriptions, from which others may arrive at similar conclusions: that there were, indeed, growths secondary to adamantine epitheliomata.

Bloodgood (8) compares adamantine epithelioma to glioma. Both are malignant, although neither metastasizes. He has seen 8 deaths in patients with adamantine epitheliomata due to extension to the brain or to septicæmia.

It is difficult to obtain from the reports of these tumors the final outcome in any large group of cases. Derujinsky (16), Hildebrand (27), and Monguidi (39) report recurrences after excision of the tumor without resection of the jaw. Becker (4) reports a recurrence 3 years after removal of the tumor and that part of the alveolar process immediately surrounding it. There were no recurrences following extensive resections in the cases, reported by Chibret (14), Hassler (26), and Hammer (25), after 2, 2, and 10 years respectively. Albarran (1) reports a recurrence 18 years after a radical resection. The resection, however, was preceded by several incomplete operations.

Bloodgood (7) states that, early in his experience with these tumors, advanced growths were the rule. Even in these patients with large tumors, no recurrences resulted, if a complete, *en bloc* resection was done as the primary operation. However, after the tumor had recurred, following an incomplete removal, the most extensive operation did not cure. At the present time, the large tumors are less often seen, due to earlier medical consultation. However, recurrences of small tumors are now more frequent because of lack of recognition by the physician and of consequent improper treatment. Often these tumors cannot be absolutely diagnosed preoperatively. In these cases adamantine epithelioma should always be considered, and, if the tumor is large, the approach should be by an external incision, in order that a thorough removal may be done, if the tumor proves to be of the adamantine group.

Bloodgood (8) has treated recurrent adamantine tumors by cutting away a piece of bone shell through an external incision, and removing the soft tissue with a swab, moist with carbolic acid. This is followed by the application of alcohol and 50 per cent zinc chloride solution; then by the thorough use of the actual cautery, and subperiosteal resection of all of the bone shell. One patient,

treated in this manner, after 2 previous curettings was well 3 years after the operation. Murphy (43) has used electrocoagulation in place of the actual cautery. Neither simple curetting nor X-ray therapy has cured adamantine epithelioma.

SUMMARY

Two adamantine epitheliomata are reported: one, a practically solid tumor, occurring in the right side of the upper jaw of a man of 58 years, following the formation of an alveolar abscess, present for 8 years before treatment, and recurring 3 years after removal by the curette and electrocautery; the other an infected tumor, occurring in the left side of the lower jaw of a woman of 25 years, following the removal of an impacted, third, molar tooth, and present for 2½ years before operation.

The work of Malassez and Galippe is reviewed, for it best explains the varied structure of adamantine epitheliomata, and furnishes an excellent basis for the understanding and diagnosis of these tumors.

BIBLIOGRAPHY

1. Albarran. Rev. de chir., 1888, viii, 429.
2. Audry. Cited by Galippe; also Soc. de biol., 1888, May 5, 424.
3. Bakay. Cited by Winter; also Berl. klin. Wchnschr., 1909, nr. 13.
4. Becker. Arch. f. klin. Chir., 1894, xlvii, 52.
5. Bennecke. Deutsche Ztschr. f. Chir., 1896, xlii, 429.
6. Bernays. Med. Record. 1885, xxviii, 1.
7. Bloodgood. J. Am. M. Ass., 1904, xliii, 1124.
8. Idem. New York, M. J., 1924, xxiv, 379; also discussion of Murphy (43).
9. Boidin and Delval. Presse méd., 1908, xvi, 793.
10. Boularan. Cited by Galippe.
11. Bryck. Arch. f. klin. Chir., 1880, xxv, 793.
12. Buchtemann. Arch. f. klin. Chir., 1881, xxvi, 249.
13. Carnathan. J. Tennessee St. M. Ass., 1922, xiv, 408.
14. Chibret. Arch. de méd. experim. et d'anat., 1894, vi, 278.
15. Cignozzi. Riform. med., Naples, 1906, xxii, 1065.
16. Derujinski. Wien. klin. Wchnschr., 1890, iii, 775.
17. Eve. Brit. M. J., 1883, i, 1.
18. Ewing. Neoplastic Diseases, 1919, Chapter 35.
19. Falkson. Cited by Galippe; also Arch. f. path. Anat., etc., 1879, lxxvi, 504.
20. Ferrero. Riforma med., Naples, 1906, xxii, 13.
21. Forgue. Cited by Galippe.
22. Fritsch. Beitr. z. klin. Chir., 1908, lvii, 193.
23. Galippe. Le débris epithel. paradent, originé, varietés, rôle physiol. et tumeurs qui en dérivent. Paris: 1910.
24. Graves. Am. J. M. Sc., 1917, cliv, 313.
25. Hammer. Arch. f. path. Anat., etc., cxlii, 503.
26. Hassler. Arch. f. klin. Chir., 1896, liii, 749.
27. Hildebrand. Deutsche Ztschr. f. Chir., 1890–1891, xxxi, 282.
28. Horsely. Ann. Surg., 1924, lxxix, 358.
29. Kinoshita. Deutsche Ztschr. f. Chir., 1909, cii, 293.
30. Kolaczek. Arch. f. klin. Chir., 1877, xxi, 442.
31. Krompecher. Beitr. z. Path. Anat. u. allg. Pathol., 1918, lxiv, 165.
32. Kruse. Arch. f. path. Anat., etc., 1891, cxxiv, 137.
33. Kuru. Zentralbl. f. allg. Path. u. path. Anat., 1911, xxii, 291.
34. Lérard. Cited by Galippe; also These de doct. de Lyon, 1900.
35. Lewis. Surg. Gynec. & Obst., 1910, x, 28.
36. Malassez. Arch. de Physiol. norm. et path., Paris, 1885, v, 129.
37. Massin. Arch. f. path. Anat., etc., 1894, cxxxvi, 328.
38. Matsuoka. Deutsche Ztschr. f. Chir., 1904, lxxiv, 594.
39. Monguidi. Cor.-Bl. f. Zahnaerzte, 1895, xxiv, 17.
40. Morestin. Soc. de Chir., 1907, p. 354.
41. Morlet, A., and J. B. Presse méd., 1925, xxxiii, 677.
42. Muller. Surg. Clin. N. Am., 1921, i, 255.
43. Murphy. Radiol., 1924, iii, 377.
44. Nasse. Cited by Galippe.
45. New. J. Am. M. Ass., 1915, lxiv, 34.
46. Nové-Josserand and Berard. Rev. de chir., 1894, xiv, 477.
47. Perier. Cited by Malassez, p. 397.
48. Perthes. Cited by Winter; also Deutsche Chir., 1907, xxxiii, 90.
49. Pincus. Arch. f. klin. Chir., 1903–1904, lxxii, 995.
50. Prym. Arch. f. path. Anat., etc., 1897, cviii, 93.
51. St. Germain. Cited by Malassez, p. 391.
52. Schlosser. Arch. f. klin. Chir., 1923, cxxiv, 679.
53. Souligoux and Pilliet. Soc. d'anat., 1892, Dec. 811.
54. Steensland. J. Exper. Med., 1905, vi, 377.
55. Stumph. Zentralbl. f. allg. Pathol. u. pathol. Anat., 1910, xxi, 393.
56. Wiemann. Cited by Galippe; also Inaugural dissertation, Berlin, 1895.
57. Winter. Arch. f. klin. Chir., 1923, cxxii, 567.
58. Wohl. Ann. Surg., 1916, lxiv, 672.

TRANSPLANTATION OF SKIN[1]

By JOHN STAIGE DAVIS, M.D., F.A.C.S., Baltimore, Maryland
From the Surgical Department of the Johns Hopkins University and Hospital

PROBABLY no procedure in the whole field of surgery is more generally useful than skin transplantation, the purpose of which is to hasten the healing of defects in the integument and also to prevent as far as possible future cicatricial contracture. We seldom have a case which needs extensive reconstructive work which does not require skin transplantation of one type or another. Consequently a good working knowledge of the subject is necessary for the general surgeon and essential for the plastic surgeon who must be familiar with the technique and the possibilities of all types of skin grafts.

Many years ago, when I began to interest myself in skin transplantation, I recollect very well that a famous surgeon told me that I was wasting my time as there was little more to be learned about it. From his point of view doubtless that was true, but he did not pass his knowledge on to me, or to others. As a matter of fact, I soon found that there were many things to be learned which were not taught and had not been published, and I feel as my experience widens that we have so far only touched the subject and that much can be done to make skin transplantation more effective and more widely utilized.

Transplantation of skin means grafting of skin; therefore in the following remarks the matter will be approached from that standpoint, and the use of pedunculated flaps will not be considered. No attempt will be made to cover the various techniques of skin grafting used by surgeons everywhere, or to present anything as new, and only those routine procedures which I am using with satisfaction at the present time will be described.

TERMS

A skin graft consists of the full thickness of the skin, or a portion of the thickness of the skin, without subcutaneous tissue, which is cut free to be transplanted wherever desired, and which receives its blood supply from the surface on which it is placed.

A skin flap on the other hand consists of the whole thickness of the skin and as much subcutaneous tissue as is required, and is attached at some portion of its periphery or base by a pedicle through which it receives its blood supply. A flap can be shifted only so far as its pedicle will allow.

At one time, I included pedunculated skin flaps in the group with whole thickness grafts, but have since come to the conclusion that this is not correct, and that on account of the difference in surgical procedure, indications, blood supply and results, flaps and grafts should be considered as entirely separate entities.

Grafts may be divided into two general types, *thick* grafts and *thin* grafts. In the thick graft group belong "small deep grafts" and whole thickness grafts. In the thin graft group should be placed the original small thin Reverdin grafts and the larger Ollier-Thiersch grafts of the same thickness.

An autograft is a graft obtained from the patient himself; *an isograft* is a graft obtained from another individual of the same species; *a zoograft* is a graft obtained from a lower species.

No one can dispute the fact that when they are available autografts should always be used in preference to other types, as the likelihood of success is very much greater.

There is much difference of opinion as to the usefulness of isografts. At the present time, I seldom use isografts, and I doubt if anyone else with much experience in skin grafting uses them, as we rarely find a patient so denuded as not to be able to supply sufficient skin for small deep autografts. However, I have not changed my opinion in spite of recent papers saying that isografts are never successful, but still feel convinced that when it is not possible to obtain autografts,

[1]Prepared for presentation before the Clinical Congress of the American College of Surgeons, Montreal, October 27, 1926.

isografts are well worth trying and may give good lasting results. It may not seem biologically possible for an isograft to take permanently, but clinically it is possible, and I have cases in which the isografts have lasted for years without breakdown. It was hoped that blood grouping might settle the question of successful isografting, but it did not. The danger of severe anaphylactic symptoms must be thought of when we deal with isografts, as when these occur in an already much depleted patient, serious results may follow. When isografts are used, care must be taken not to transfer disease from the donor to the recipient as instances have been reported in which syphilis, tuberculosis, and smallpox have been transmitted in this manner.

I have never been able to secure a permanent healing with zoografts and for this reason have ceased using them. However, in a number of cases reported, it is said that good results have been obtained, especially with the skin of young pigs and puppies, but whether these grafted areas have stood the test of time, I am unable to say.

The term *complete take* means that the entire graft has lived. *Partial take* means that only a portion of the graft has lived.

SOURCE OF GRAFTS

Grafts may be obtained from almost any available portion of the skin surface. The region from which the graft is taken has little if any effect on the success or failure of the graft although I find that better results are obtained when "small deep grafts" or whole thickness grafts are cut from areas where the skin is not too thick. When a graft of whole thickness is used in certain regions such as around the eyelids, thin hairless skin should be selected such as that from the inner upper portion of the arm or from the prepuce, and as a rule the skin should be selected with regard to the area into which it is to be placed. When hair-bearing skin is desired, it may be obtained from the scalp, the pubis, the axilla, and in especially hairy individuals from the thigh and forearm. When practicable, it is always advisable to take grafts from an area where the resulting scar can be covered by clothing. When cutting an Ollier-Thiersch graft, I prefer to use the thigh or leg rather than the arm, as larger grafts can be obtained without causing a conspicuous scar. The material for isografts may be obtained from voluntary donors who are nearly always available. In any of the usual operative procedures material may be obtained by removing an elongated ellipse of skin instead of making a straight incision, the wound being closed as usual.

SURFACE ON WHICH GRAFTS MAY BE PLACED

Everyone knows that skin grafts may be placed on fresh operative wounds, and that one type or another will take on fat, fascia, tendon, muscle, perichondrium, periosteum, and freshly denuded bone. Before the graft is placed on a fresh wound, the bleeding must be completely checked. All types of grafts will also take on healthy, undisturbed, granulating surfaces. As a matter of fact, it is frequently advisable to let granulations form before the graft is applied especially when the blood supply of the area to be grafted is doubtful. The capillary loops of healthy granulation tissue are already formed and naturally can enter the graft sooner when they do not have to develop after the graft has been applied.

Granulation tissue suitable for grafting must be clean, firm, rose pink in color, and not exuberant. One can tell more by the appearance of a granulating surface as to the likelihood of a take than by a bacterial count, as frequently a bacterial count may be high and the granulating surface clinically perfect for grafting. Of course, if the appearance of the granulations is right and the bacterial count is negative, we have the ideal condition, but personally I depend more on the appearance of the granulating surface than on the count.

PREPARATION OF THE GRANULATING AREA FOR GRAFTING

The preparation of a granulating area usually presents one of two problems, either the granulations are boggy and exuberant or there is great difficulty in stimulating satisfactory growth.

In dealing with boggy and exuberant granulations, several methods are useful. Nitrate of silver, either in stick or saturated solution may be freely applied. Trimming off the granulations with curved scissors followed by the use of silver nitrate is a quick method. Compresses of iodoform or bismuth gauze saturated in glycerin are very helpful. Dakin's hypochlorite solution used either by the Carrel technique or on compresses is often effective. Another useful method is to paint the entire area either with tincture of iodine or with pure carbolic acid, then curette down to the firm base, wash with ether, and dress with gauze saturated with boric ointment or 3 per cent xeroform ointment. Usually within 48 hours the granulations are ready for grafting. Snug strapping with adhesive strips will sometimes flatten the exuberant granulations.

When granulation is sluggish, the problem changes as stimulation is necessary. For this purpose compresses saturated with normal salt or boracic acid solution are preferable to Dakin's hypochlorite solutions. Gauze saturated with balsam of Peru either undiluted or in combination with castor oil, 1-3, is helpful. A saturated solution of silver nitrate over the entire area followed immediately by tincture of iodine (forming silver iodide) is worth trying. Compresses saturated with sodium chloride solution 15 to 20 per cent, or glucose solution 20 per cent will occasionally start granulations on a very sluggish base. Painting with nitrate of silver solution, 2 per cent, is also worth trying. In an extensive wound, such as that of a completely denuded thigh and leg, we seldom find the granulations on all parts of the wound in the same condition. For this reason, several kinds of treatment may have to be used on different parts of the same wound. In such cases, it is advantageous to graft the areas ready for grafting and then apply more grafts as the granulations in other portions become fit.

Heliotherapy is useful in all types of granulating wounds, in the form of continuous electric light baths, and real or artificial sunlight in suitable amounts, but is especially salutary when we are dealing with boggy granulations.

METHOD OF PREPARING HEALTHY GRANULATIONS TO RECEIVE GRAFTS

After the granulations are in good condition, on the day preceding the grafting, the surrounding skin and granulations should be thoroughly cleaned and the granulating area dressed with a thick pad of gauze saturated with normal salt solution. If Dakin's solution has been used up to this time, this is worth doing as I have observed that grafts do not take as well on an area which has been treated with Dakin's solution up to the time of grafting. At the time of operation, the gauze is removed, the wound is washed with ether followed by normal salt solution, care being taken not to cause bleeding. The surface is then dried and a pad of dry gauze is placed over the wound and pressed down firmly. This gauze is removed just before the grafts are applied. It is important that the surface to be grafted should be dry but not glazed, as the grafts adhere better to such a surface. The skin surrounding the wound may be cleaned by any method desired.

ANÆSTHESIA

All types of grafts may be cut under local anæsthesia induced either by infiltration or by nerve blocking. Infiltration seems to have little, if any, detrimental effect on the subsequent healing of the graft, although blocking is preferable. However, general anæsthesia is necessary in cases of extensive grafting. The decision as to the type of anæsthesia in each case must be left to the judgment of the surgeon.

THE PREPARATION OF THE AREA FROM WHICH THE GRAFT IS TO BE CUT

The safest method of preparing the area from which the graft is to be cut is to shave the area, then scrub thoroughly with green soap and water followed by alcohol and ether. This is quite a long sloppy process, and we are inclined to shirk it for the following simpler procedures. After a dry shave, the selected area is painted with several coats of tincture of iodine, 2.5 per cent. Another quick method is to paint the area with a solution of potassio-mercuro-iodide (Kalmerid) 4 grams to 460 cubic centimeters

of acetone. Painting with picric acid 5 per cent in alcohol is also excellent.

DRESSING OF THE AREA FROM WHICH THE GRAFT IS CUT

I find that silver foil is the best dressing for the area from which "small deep grafts" and Reverdin grafts have been cut. The foil is placed over the area in a number of layers and over it the porous paper which separates the leaves. Finally a flat, dry gauze dressing secured by adhesive plaster and a bandage is applied. This dressing is left on for about 2 weeks and when it is removed, the little wounds will be healed. The sutured wound from which a whole thickness graft has been removed should be dressed as any ordinary sutured wound.

A poorly applied dressing for the surface from which an Ollier-Thiersch graft has been cut may cause much unhappiness to both patient and surgeon, especially if it sticks. My preference again is for silver foil; and after a number of layers have been applied with the porous paper on top, this is covered with perforated cellosilk or rubber protective in which small openings have been cut. The cellosilk or protective should extend well beyond the raw surface and should be carefully glued to the skin. Over this should be placed a flat pad of sterile gauze secured by adhesive plaster and a bandage. If there is no discomfort this dressing should not be disturbed for at least a week. Then the protective or cellosilk should be removed, and the denuded surface gently irrigated. The type of dressing at this stage depends on the appearance of the wound.

THICK GRAFTS

Thick grafts as mentioned are grouped into "small deep grafts" and whole thickness grafts.

Technique of applying "small deep grafts." An intestinal needle firmly held in an artery clamp is engaged in a bit of epidermis which is raised so that a little cone is formed. The base of this cone is cut through after the blade of the knife is depressed.

Properly cut grafts are either round or irregularly oval and vary between 0.2 and 0.4 centimeter (about $^1/_{12}$ or $^1/_6$ inch) in diameter. They are thickest in the center where the full depth of the skin is frequently used and taper off toward the edges. There should be a narrow rim of untouched epithelium between the pits left by cutting the grafts.

The graft still on the needle may be transferred at once to the wound. If this method is used a number of clamps and needles are necessary, each needle being flamed before it is returned to the operator in order to avoid possible infection from the granulating area. A simpler method is to place the graft on a folded towel where it is picked up on another needle by the assistant who is applying the grafts. This procedure also has the advantage of removing any blood which may be on the raw surface of the graft.

The grafts should be placed in rows, raw surface down, no attempt being made at this time to uncurl the edges, a space of about 0.5 centimeter ($^1/_5$ inch) being left between the grafts. After two or three rows have been applied a strip of rubber protective about 2.5 centimeters (1 inch) wide, in which "V" shaped slits have been cut, and long enough to extend well out on the normal skin is placed over the grafts so that they are all covered. Then with a gauze pledget, firm pressure is made directly downward on the protective. This will uncurl the edges of the grafts and spread them out evenly on the granulations. More rows of grafts are put on and then another strip of protective is placed so that it will partly overlap the one previously applied. This procedure is continued until the desired area is covered. The ends of the protective strips are secured firmly to the surrounding skin by means of a few drops of chloroform. Sometimes I use strips of perforated cellosilk instead of rubber protective, and secure it to the skin by a mixture of equal parts of absolute alcohol and ether. Over the protective, a piece of sterilized sea sponge should be fitted to fill up the defect and over this a thicker sea sponge secured under even pressure by adhesive plaster and a bandage. This immobilizes the grafts and holds them firmly against the granulating surface.

Many years ago, when I developed this type of graft, I found, after considerable experimentation, that the overlapping strips of protective furnished the most satisfactory dressing for "small deep grafts" and have seen no reason to change this simple procedure for any of the complicated and troublesome methods which have since been exploited. In the last few years, the sea sponge has been used over the protective as an improvement on gauze; otherwise there has been no change.

Postoperative treatment of small deep grafts. The part grafted should be immobilized. As a rule, the patient should be kept in bed for a longer or shorter period, depending on the size and situation of the grafted area. If the grafts have been placed on a granulating wound the original dressing should be changed after 48 hours and the secretions gently mopped off or removed by irrigation with normal salt solution. If the grafts have been placed on a fresh wound the first dressing may be delayed for a week. Within 48 hours those "small deep grafts" which will live become a dusky pink with a deeper more blotchy area of ecchymosis in the center. A slight halo of newly formed epithelium can usually be seen around each graft. Those grafts which will not take are pearly white in color, and although they may be adherent will come away with the dressings after a few days.

Ordinarily we do not see Ollier-Thiersch and whole thickness grafts as early as 48 hours after operation, but when we do we are frequently able to note the same dusky pink color of the successful portions.

When we are dealing with a granulating surface, and the grafts are doing well, it is often advisable to use protective strips and gauze instead of the sea sponge for the second and third dressings; then to shift to some bland ointment spread on old linen. I still use scarlet red ointment, 8 per cent, when the grafts are sluggish and find it most satisfactory. Should the granulations between the grafts become exuberant, compresses saturated with Dakin's solution may be used after the fifth day without detriment to the grafts. As soon as the new epithelium from the wound edges and grafts has covered the wound, stearate of zinc powder and exposure to the air is helpful. The grafted area should be protected from injury for several weeks. After about 3 weeks, gentle massage is advisable and should be continued until the area slides easily over the underlying tissues. There is usually marked desquamation of the grafted surface for some months after healing has taken place, but this scaliness can be controlled by the application of cold cream, olive oil, or cocoa butter.

Comments. "Small deep grafts" are used on granulating wounds more frequently than on fresh wounds. Almost invariably there is stimulation of epithelium from the wound edges following the application of these grafts and successive graftings cause successive stimulations.

There is frequently very marked shrinkage in the size of a wound after successful grafting with "small deep grafts." The resulting cicatrix is solid and resistant. Contraction may occur under an area grafted with these grafts, but is much less likely to occur than when grafting is not done. On account of the dotted appearance of a surface successfully grafted with "small deep grafts," it is inadvisable to use them on the face and other exposed positions except in special instances. Occasionally a keloid will form in the grafted area or in the area from which the grafts are cut. There is no way so far as I know to prevent this or to tell when it will occur.

A large number of grafts can be obtained from a very small area, and they can be cut under local anæsthesia with little discomfort to the patient. Healing is much expedited by the use of these grafts. The difference in the stability and character of the result obtained from small thin Reverdin grafts and "small deep grafts" is almost as marked as that between thin Ollier-Thiersch grafts and whole thickness grafts.

Technique of applying whole thickness grafts. It is advantageous to use dry technique until the graft is sutured into position. An accurate pattern of the wound to be grafted is made with tin foil or perforated cellosilk or careful measurements are taken. The pattern is

marked out on the selected area with brilliant green, 5 per cent in alcohol. In the majority of instances, the pattern can be marked out inside of an elongated ellipse of skin, thus making a line closure possible. Then with a sharp knife the full thickness of the skin around the pattern is cut through, one edge of the graft raised with a double dural hook, and the skin dissected from the underlying tissue so that practically all the fat is removed. The graft is handled very gently to avoid bruising. The graft is folded, raw surface to raw surface, and wrapped in dry gauze. In order to save time the wound from which the graft is taken is closed by the assistant, and ordinarily this is not a difficult procedure. If after the removal of the exposed fat and in some instances the undercutting, complete closure is not possible, then the remaining open wound may be allowed to heal by granulation or may be covered with an Ollier-Thiersch graft or with "small deep grafts." The wound on which the graft is to be placed should be perfectly dry. If the graft is more than 3 centimeters in diameter, it is perforated with a fine punch or by a stab wound in one or two places to allow drainage, and is then carried to the wound, fitted in place and held by cardinal on-end mattress sutures of horse hair which go through the full thickness of the skin and graft. Additional interrupted sutures placed more superficially are then inserted, so that the graft is accurately approximated to the wound edges. The tension of the sutured graft should be about that of the normal skin.

In my hands the following has been found to be the most satisfactory dressing for whole thickness grafts. Two or three layers of gauze impregnated with 3 per cent xeroform ointment or a number of layers of silver foil are placed smoothly over the graft, and then the sterile sea sponge as previously described is applied. The sponge must be perfectly even over the graft so that the pressure may be equal in every part and the pressure must be just sufficient to obliterate dead spaces, hold the graft snugly against the raw surface, and immobilize it. Some experience is necessary in order to get the right amount of pressure, but this is not difficult to acquire. Too much pressure may cause necrosis, too little destroys the value of the dressing. If a whole thickness graft is placed on a healthy dry granulating surface, it can be spread out nicely and will adhere closely. Should the stretch of the skin not be sufficient, a few sutures will correct the trouble. The sea sponge dressings should also be used. The part, of course, should be immobilized and the patient kept quiet.

Postoperative treatment of whole thickness grafts. If there is no danger of contamination, I leave these dressings on from 2 to 3 weeks, although 8 to 10 days is actually sufficient. In regions where soiling takes place, the sponge and underlying dressing should be changed whenever necessary, and a similar dressing applied. On a granulating surface after the first 48 hours, the sea sponge should be changed every day for 8 to 10 days.

In those instances in which blisters form, they should be opened, the secretion released, and the dressing reapplied. Superficial infections should be treated with dahlia, 2 per cent, in distilled water; mercurochrome, 2 per cent; or 2.5 per cent tincture of iodine. Compresses saturated with normal salt solution or Dakin's solution are sometimes useful. If there has been sloughing of the epithelial layers leaving the corium intact, it may be advisable to hasten epithelization either by the use of epithelial scrapings, small very thin Ollier-Thiersch grafts, or true Reverdin grafts. The graft should be protected from injury for about 6 weeks. Massage is beneficial in improving the circulation and in breaking up the marginal scar tissue.

In a series of experiments on the blood supply of whole thickness skin grafts, Dr. Traut and I found that removal of the subcutaneous fat with scissors pinched off many of the vessels in the graft and thus interfered with the earliest nourishment of the graft. We also found that the contraction of the elastic fibers in the skin occluded the vessels, and for that reason when securing the graft in position, we apply tension equal to that of the normal skin to overcome this tendency.

Whole thickness grafts may be used in any situation desired but are especially useful in areas where there is constant trauma such as over the joints, on the hands, etc. Contracture is much less likely to occur under these grafts than under any other type of graft. When a whole thickness graft is placed on a granulating surface, it may at first project above the surrounding skin, but eventually, it will assume the normal level.

When asepsis is possible, whole thickness grafts may be wrapped around molds of dental compound and be buried to line cavities or give relaxation with even better results than Ollier-Thiersch grafts will give. They may also be buried under pedunculated flaps for the purpose of lining the portion desired.

Large whole thickness grafts, for example, 10 by 20 centimeters (4 by 8 inches), may be successfully transplanted. The tendency for one unfamiliar with these grafts is to limit them to a few centimeters in length, as many also do with Ollier-Thiersch grafts, but the large grafts of both types take as well as small ones. The only trouble is that it is more difficult to apply even immobilizing pressure over a large area. It is always preferable to apply a single graft but sometimes it may be necessary to use more than one graft, in which case, the procedure is carried out just as when a single graft is used except that the grafts are sutured together where they come in contact. Sometimes it is advisable to insert immobilizing sutures through various portions of the graft into the underlying tissues.

Keloid may develop in the scar from which a graft of whole thickness is taken as it may in any other sutured wound. I have also had two cases in which keloid developed in and around the whole thickness graft itself, both being in burns with extensive keloid formation elsewhere.

When we are dealing with an extensive scar which cannot be excised completely and when it is not practical to use a pedunculated flap, greater ultimate relaxation can be obtained by excising the binding portions and making necessary relaxation incisions, then undercutting the margins and implanting the measured whole thickness graft, the edges of which are drawn by sutures to the limit of the undercut. The raised margins smooth out in time and good results are obtained.

The operative procedure is more extensive, and in some instances, the postoperative care is more difficult in whole thickness grafting, but the ultimate result in a successful whole thickness graft is as stable, firm, and pliable as the normal skin.

THIN GRAFTS

Thin grafts may be of the Reverdin or Ollier-Thiersch types.

Reverdin grafts may be obtained by the same technique as has been described for "small deep grafts" except that the tip of the cone raised by the needle is removed rather than the base. In other words, an attempt is made to cut a bit of skin which includes the epithelial layer and as little of the corium as possible.

Reverdin originally described his grafts as pure epidermal grafts, but later found that each one contained a thin layer of corium. My own experience shows that true Reverdin grafts are very difficult to cut, they have no single advantage over "small deep grafts," the ultimate results are not nearly as stable, and contracture is more likely to occur. Nowadays this type of graft is seldom used.

The thigh is usually the area from which *Ollier-Thiersch grafts* are selected. A sand bag is placed beneath the thigh. Then firm traction is made on the foot and the skin, thoroughly wet with normal salt solution, is put on the stretch and flattened by means of two pieces of splint board about 8 inches long. These are at first placed quite close together and at right angles to the length of the limb, one being held by the assistant and the other in the left hand of the operator. A long, broad bladed, very sharp single edged knife held almost flat against the limb is then lightly engaged in the skin between the boards and by a sawing motion the graft is cut, the knife following the board in the hand of the operator which is drawn slowly along in front of it. The graft should be very thin throughout, not thicker than tissue

paper, and should be cut at a level which will include only the epithelial layer and the tips of the papillæ of the corium. If the graft is properly cut only a slight amount of punctate bleeding will follow.

After the graft has been cut, it is spread out smoothly with a blunt instrument raw surface up on a piece of rubber protective placed on a board. It is then covered with gauze wet with normal salt solution until the area to be grafted is ready. When the wound is dry, the graft still on the protective is applied raw surface down and the protective is gradually removed, the graft being left in place. It is straightened out and pressed down evenly on the wound with gauze pledgets, "V" shaped cuts being made here and there to allow the immediate escape of air bubbles and subsequent discharge of serum which may collect. Ordinarily, the graft will stay snugly in place, but occasionally fine silk sutures placed here and there through the graft may be used to hold it. In certain situations rubberized mesh is also useful for immobilizing Ollier-Thiersch and whole thickness grafts.

If more than one graft is used, they should overlap the wound margins and also overlap each other slightly. Sometimes, I use silver foil and sometimes gauze impregnated with 3 per cent xeroform ointment immediately over the grafts, and over this a sterile sea sponge applied as previously described. The part should be immobilized and the patient kept in bed.

Postoperative treatment of Ollier-Thiersch grafts. If the wound is clean, 10 days may elapse before the grafted area is dressed. On a granulating wound the first dressing should be done in 48 hours. The secondary dressings on fresh and granulating wounds vary according to conditions; foil, ointment, and compresses being used as indicated. The grafted area should be protected for several weeks and massage should be started about 2 weeks after healing is complete.

Comments. The Ollier-Thiersch graft is the type most commonly used. A single Ollier-Thiersch graft may be cut the full length of the thigh and several inches wide, but this requires considerable skill. Ordinarily these grafts are cut with a razor in small strips which are pieced together, but the results are not as satisfactory as when a single graft is used.

Occasionally, a keloid will develop in the wound from which an Ollier-Thiersch graft is cut, and also in the grafted area. Contracture sometimes occurs under a successful Ollier-Thiersch graft, and there is no way of anticipating or preventing it.

The accurate cutting and fitting of Ollier-Thiersch grafts by pattern in much the same manner as that used with whole thickness grafts has been advocated, but is unnecessary as the graft will usually take when applied to a raw surface and dries up where it overlaps, a very accurate approximation resulting.

The results of Ollier-Thiersch grafting are usually good, but in exposed situations they are not so durable as whole thickness grafts. I have seen cases in which years have passed without the graft having loosened from its bed; on the other hand whole thickness grafts soon become movable.

Ollier-Thiersch grafts are frequently used in what is known as buried grafting on dental compound molds and give excellent results. They are also often used on dental compound molds in lining cavities in the mouth, and take well if properly immobilized, even though exposed to the infection of the buccal cavity.

HISTOLOGICAL CHANGES

The blood supply of whole thickness skin grafts is established in three ways: (1) by anastomosis of small capillaries of about the same caliber, (2) by the upward growth of capillaries inside the old vessels, and (3) by the invasion of capillaries from the host tissues. The last is the slowest means as well as that supplying the permanent vessels. The earliest time at which we have been able to demonstrate circulation in the graft is at the end of 22 hours. Adequate circulation which can determine the survival of the graft is not established until the eighth day. The graft is nourished in the interim by two means: a plasmatic circulation (migration of great numbers of round and wandering cells into the old vessels as well as into the connective

stroma of the corium) which is most important; and the early anastomosis of small capillaries.

Much the same process takes place in the development of the blood supply of Ollier-Thiersch, Reverdin, and "small deep grafts," but probably the plasmatic circulation does not play so important a part because in these grafts the body fluids with their cellular content can more easily penetrate and nourish, and a blood supply sufficient to cause survival is much more quickly established.

It must be understood also that during this period of the development of the blood supply in whole thickness grafts, very marked degenerative processes are also taking place, in the epidermis, in the connective tissue of the corium, and in the endothelium of the vessels.

Hair follicles and sebaceous glands are the most resistant elements in the skin. The degenerative processes continue until the seventh or eighth day when apparently a balance is reached and proliferation of the surviving elements is in excess of the degeneration.

The nerve supply of all types of grafts comes in from the periphery and begins to develop within 4 or 5 weeks, tactile sensibility first, then pain, and lastly temperature sense.

RESULTS

The question is constantly being asked, "What is the percentage of takes in this or that type of graft?" This is a difficult question to answer, and would be easier if it were put in the form of "What are the ultimate results?"

In whole thickness grafting, it is seldom that we have a complete failure if the graft is properly placed on a surface in suitable condition, and is immobilized with an appropriate dressing. The epithelial layer will in some instances remain intact, in others there is more or less loss of this layer. Sometimes only the corium or a portion of the corium remains, but eventually even if only a portion of the corium remains, the result will be good.

The results with "small deep grafts" are uniformly satisfactory if the granulations on which they are placed are healthy and in good condition, and if the grafts are not damaged in the cutting and are properly applied and immobilized.

The results with Reverdin grafts are equally successful as far as healing is concerned, but the ultimate results on a granulating wound are never as good as those obtained with "small deep grafts."

Ollier-Thiersch grafts take readily on a suitable surface, but what seems to be an utter failure at the first dressing will often later give a satisfactory result. The entire thickness of an Ollier-Thiersch graft may live, then again the superficial layers may become macerated.

The development of a thin layer of fat under whole thickness grafts, which is well marked after about 3 weeks, makes these grafts less liable to adhere to the underlying tissues and consequently more freely movable.

Brownish pigmentation may occur in all types of grafts after healing is complete, and although various suggestions have been made to avert this, I know of no procedure by which pigmentation may surely be prevented.

HYPERINSULINISM

By H. J. JOHN, M.D., Cleveland, Ohio
Cleveland Clinic

THE term hyperinsulinism is employed to indicate a group of symptoms which are caused by a prolonged overdosage with insulin. This term was first employed by Harris in 1924 when he described not only the hypoglycæmic symptoms produced by exogenous insulin, but also other forms of hypoglycæmia found in non-diabetic patients. The chief symptom of this condition was a marked degree of hunger before meals associated with a fasting hypoglycæmia. Apparently in these cases there was a dysfunction or hyperfunction of the islands of Langerhans, as these patients were relieved by the administration of exogenous carbohydrates.

In my first paper on hyperinsulinism[1] I reported the case of a man 38 years of age who for 3 weeks in each of several successive months had been taking 10 units of insulin twice a day because of glycosuria, on the basis of which the diagnosis of diabetes mellitus had been made. He became very nervous, his pulse rate increased to 120, he lost 27 pounds in weight, and, because of these symptoms, an additional diagnosis of hyperthyroidism was made by his family physician. Radium was applied to the thyroid gland, which showed no external enlargement—the insulin being continued. As the symptoms were not relieved by this treatment, the patient was sent to Dr. Crile for thyroidectomy. On arrival his basal metabolic rate was plus seven. The urine showed heavy glycosuria, but the blood sugar was only 110 milligrams per 100 cubic centimeters. The Wassermann test was negative. A glucose tolerance test made on the following day showed a perfectly normal curve, thus ruling out diabetes. The insulin was therefore discontinued and the symptoms immediately subsided. A test which was made recently—2½ years after the first examination—shows that the blood sugar content has remained low, in spite of the discontinuance of insulin.

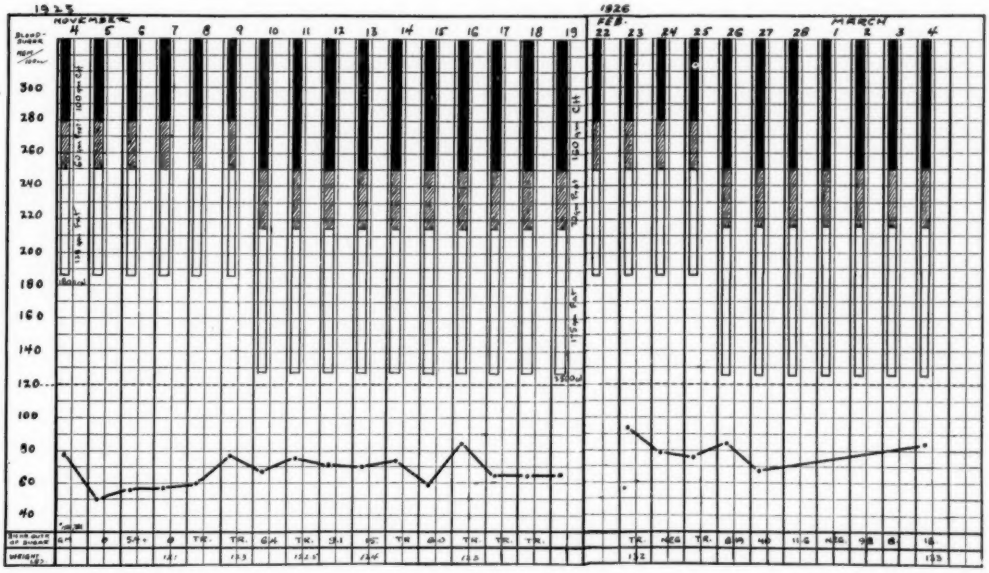
An interesting point which was brought out in this case was the very low renal threshold for sugar, for when the blood sugar fell from 118 to 64 milligrams per 100 cubic centimeters glycosuria was still present, and the total daily output of urine sugar reached 52 grams. The following table gives the fasting blood sugar and urine sugar values during the 10 days immediately after insulin treatment was abandoned:

Day.....	1	2	3	4	5	6	7	8	9	10
Blood sugar mg/100 c.cm.	110	94	193 (2 hrs. p. c.)	76	107	103	97	72	114	95
Urine sugar..	++++	tr	++	++	++	++	+++	++	++	++

As is indicated by the case described above, the symptoms of hyperinsulinism resemble those of hyperthyroidism so closely that the former condition is easily mistaken for the latter and it is in this connection that I am reporting a second case in order again to call attention to this subject. Since, with the advent of insulin a new functional disturbance has been introduced, it is most important that we should be able to recognize it and particularly to differentiate it from hyperthyroidism. This is especially necessary because the modes of treatment of the two conditions are entirely different.

When a diabetic patient is placed on a certain insulin dosage, for example, 20 units of insulin three times daily, this amount being just sufficient to control his hyperglycæmia and glycosuria, it does not follow that this dosage should be maintained during the whole course of treatment. The amount of insulin may have to be increased as time passes, or it may have to be decreased. If the endogenous insulogenic function of the patient improves and more endogenous insulin is provided, then less exogenous insulin is needed. In such a case the daily dosage of insulin which was prescribed at first becomes an overdose, and, if it is continued, symptoms of either mild or severe hyperinsulinism may appear. These symptoms consist of nervousness, tremor of the fingers, perspiration, tachycardia, great hunger, and loss of weight. As stated above,

[1]Ohio State M. J., 1925, xxi, 99–100.



1. Chart showing the daily progress of patient with hyperinsulinism, indicating the consistent hypoglycæmic blood sugar curve which continued even after the insulin had been discontinued and diet markedly increased.

because of the striking similarity between these symptoms and those of hyperthyroidism, the wrong diagnosis may be made and the patient may be subjected to a thyroidectomy without securing any relief from his symptoms.

The history of my second case is as follows:

This patient, a man 47 years of age, was referred to Dr. Crile with the diagnosis of hyperthyroidism, for which ligations had previously been performed elsewhere. He had been under treatment for diabetes for nearly 3 years, the diagnosis having been based on the presence of the classical symptoms of this disease. For a year and a half the treatment consisted of dietary restriction alone. In January, 1925, however, the patient's neck became slightly enlarged, he suffered a marked loss of weight and strength, his ankles became swollen, and he grew much more nervous and irritable. In February, 1925, insulin treatment was instituted and he was given 40 units per day in two doses. From February to July he grew progressively worse and lost weight and strength. It was at this time that the diagnosis of hyperthyroidism was made, and thyroidectomy preceded by ligations was recommended. In July, 1925, a double ligation of the thyroid arteries was performed. Following this operation his condition became very much worse, the heart action became irregular and rapid with an occasional missing beat and palpitation, the swelling of the ankles increased, dyspnœa occurred, and he lost 80 pounds in weight. He was sent to Dr. Crile for a thyroidectomy on November 4, 1925.

When he came to the Clinic he complained of nervousness, tachycardia, palpitation, and marked loss of weight. His weakness was so extreme that he had to be moved in a wheel chair. There was no familial history of diabetes. Among the childhood diseases he had had measles, chickenpox, scarlet fever, whooping cough, as well as pneumonia. Later he had attacks of typhoid, grippe, rheumatism and influenza. He was married and had three healthy children.

Physical examination showed a markedly emaciated and weak individual, very nervous, with only a very slight enlargement of the central lobe of the thyroid gland. The only clinical findings of significance were revealed in the examination of the heart which was definitely enlarged to the left with increased præcordial activity and ectopic beats. The swollen ankles and enlarged liver also gave early signs of cardiac decompensation.

Glycosuria was present; and the blood sugar 5¼ hours after a meal was 78 milligrams per 100 cubic centimeters. The patient was placed in the Diabetic Hospital and given a diet of 100 grams carbohydrates, 60 grams protein, 128 grams fat, a total of 1,800 calories per diem, this being raised 6 days later to 160 grams carbohydrates, 70 grams protein, and 175 grams fat, a total of 2,500 calories. No insulin was administered during the 15 days of hospitaliza-

tion except on November 5, when, by mistake, 20 units were given him. The accompanying chart shows the fasting blood sugar which was maintained on the stated diet. As will be noted, the patient had a marked hypoglycæmia during this entire period, ranging from 94 to 50 milligrams per 100 cubic centimeters, the lowest of which I have any record among those cases in which the blood sugar has consistently stayed at a low level, yet he was excreting sugar most of the time. From the data on this chart one would hardly suspect that the patient had diabetes. The following observations, made by checking the blood sugar three times a day, before breakfast, before lunch and before dinner, gave findings which seem opposed to a diagnosis of diabetes.

Blood Sugar
Determined by Meyers-Benedict Method

Date	8 a.m. mg./100 c.cm.	12 m. mg./100 c.cm.	5 p.m. mg./100 c.cm.
Nov.			
7	57	116	96
8	60	110	114
9	77	105	96

Although after the increase in diet on November 10, the noon and evening blood sugar figures are somewhat higher, as shown in the following table, yet they fall within reasonably normal limits:

Blood Sugar
Determined by Meyers-Benedict Method

Date	8 a.m. mg./100 c.cm.	12 m. mg./100 c.cm.	5 p.m. mg./100 c.cm.
Nov.			
10	67	95	128
11	75	176	123
12	71	222	125
13	70	168	157
14	73	150	140
15	59	171	130

In order to establish the differential diagnosis, a glucose tolerance test was made on November 6, 100 grams of glucose being given by mouth. The following information was obtained:

	Blood Sugar mg./100 c.cm.	Glycosuria gm.
Before ingestion of 100 grams glucose	55	negative
½ hr. after ingestion of 100 grams glucose	173	....
1 hr. after ingestion of 100 grams glucose	280	0.41
2 hrs. after ingestion of 100 grams glucose	303	2.24
3 hrs. after ingestion of 100 grams glucose	226	1.5
4 hrs. after ingestion of 100 grams glucose	171	1.24

Total water intake	1040	c.cm.
Total urine output	560	c.cm.
Total sugar intake	100	gm.
Total sugar output	5.39	gm.
Plasma chlorides	585	mg./100 c.cm.
Blood urea	20	mg./100 c.cm.
Blood uric acid	2.0	mg./100 c.cm.
Blood creatinin	1.2	mg./100 c.cm.
N.P.N.	30.7	mg./100 c.cm.
Plasma acetone	negative.	
Wassermann	negative.	

The result of the glucose tolerance test showed that we were dealing with a diabetic condition, a fact which had not been shown by the tolerance of the comparatively high caloric diet.

The basal metabolic rate taken November 9, 1925, was plus 19, on November 18 it was plus 13, and on February 24, 1926, plus 14.

Two and a half years ago the diagnosis of diabetes was first made in this case. The patient progressed fairly well on a restricted diet for a year and a half, at the end of which period it was decided that insulin might be of benefit to him. Instead of improving with its use, however, he grew steadily worse, lost weight, became nervous, suffered from palpitation and excessive perspiration, was constantly hungry, showed, in fact, all the symptoms of hypoglycæmia. At this stage these new symptoms were considered to be due to hyperthyroidism and a slight enlargement of the middle lobe seemed to confirm the diagnosis. Ligations were performed, but his condition became progressively worse, this downward course continuing as long as the insulin treatment was continued. As soon as the insulin was discontinued he began to improve and although, because of his markedly emaciated condition, his gain in weight and strength is naturally slow, it is consistent.

It is still necessary to explain the slightly increased basal metabolism. We can only say that we do not know what may be the influence of continued overdosage with insulin on the thyroid gland. It is possible that it may induce an increased metabolic rate, as is suggested by the drop of 5 per cent in the first 9 days after the insulin was discontinued. Whatever the metabolic rate may indicate, however, the fact remains that the withdrawal of insulin cleared up the other symptoms.

The tangible evidence of too much insulin or hyperinsulinæmia is hypoglycæmia. The chief symptom of hypoglycæmia is marked hunger. I first noted this symptom of hunger several years ago while doing a series of glucose tolerance tests on myself and since then have noted it repeatedly during glucose tolerance tests. In these tests the ingestion of 100 grams of glucose is followed by a rise of blood sugar, which, in normal individuals, is followed by a quick drop back to the normal level and in many cases to far below the normal level. The

explanation which has occurred to me is that by overwhelming the organism with a large dose of carbohydrate the insulogenic organ (islands of Langerhans) is overstimulated and throws a large amount of insulin into the blood stream, which in turn causes a rapid combustion of the glucose circulating in the blood stream, so that the glucose output from the liver does not keep pace with the glucose consumption and hypoglycæmia results. This hypoglycæmia is often quite marked. Examination of my records shows blood sugar values as low as 31, 36, 40, 45, 48, 49, 50, 57 milligrams of sugar per 100 cubic centimeters of blood in normal individuals—and invariably these individuals complained of extreme hunger at that stage. In the series of glucose tolerance tests which I made on myself, whenever the blood sugar curve dipped to the stage of hypoglycæmia I noted a feeling of extreme hunger. One characteristic glucose tolerance test made on myself was as follows:

			Periods after administration of 100 gm. glucose by mouth			
	Fasting	½ hr.	1 hr.	2 hr.	3 hr.	4 hr.
Blood Sugar						
Meyers-Benedict method.....	82	124	103	101	49	74
Folin-Wu method.	75	113	94	92	45	68

It was at the end of the 3 hour period that I noted this extreme hunger, and upon questioning patients during a glucose tolerance test—and often without questioning—I got similar information.

Harris[1] found that in patients who experience an abnormal feeling of hunger, this symptom was promptly relieved by a glass of milk taken between meals. He classified these as cases of functional hyperinsulinism. The question which arose in Harris' mind was whether starvation was the cause of this hypoglycæmia. He was fortunate enough to be able to use as a control, several cases of carcinoma of the œsophagus or pylorus, cases in which the patients could take practically no food and were emaciated, thus offering ideal conditions under which to secure an answer to this problem. If such a hypoglycæmia were due to a lack of food, then in these cases the patients should show a considerable degree of hypoglycæmia, but they did not. The blood sugar figures secured by him in four such cases were 90, 84, 90, 79 milligrams per 100 cubic centimeters. (N. B. Harris' measurements were made by the Folin-Wu method, and therefore 13 milligrams per 100 cubic centimeters should be added for comparison with my figures secured by the Meyers-Benedict method.) Furthermore, the glucose tolerance test in itself indicates a negative answer to the above question, since these symptoms are elicited in otherwise normal individuals. Thus since, after the ingestion of 100 grams of glucose, the following period of hunger cannot be due to lack of food but rather to too much insulin in the blood, it follows that the phenomenon must be due to some irregularity or oversensitiveness of the insulogenic regulating mechanism.

[1] Harris, S. Hyperinsulinism and dysinsulinism. J. Am. M. Ass., 1924, lxxxiii, 729–733.

CONCLUSIONS

1. The use of insulin in the treatment of diabetes must always be properly controlled in order to avoid the danger of hyperinsulinism.

2. The symptoms of hyperinsulinism are so similar to those of hyperthyroidism that it is difficult to make a differential diagnosis between these conditions on the basis of the symptoms alone. Consequently hyperinsulinism should always be ruled out by a blood sugar examination, if hyperthyroidism is suspected in a patient who is being treated with insulin.

3. The treatment of hyperinsulinism is simple—merely the discontinuance of insulin. If this be insufficient the administration of some food between meals will be effective.

4. Voracious hunger a few hours after the administration of insulin usually indicates hypoglycæmia.

5. Urinary examination alone is not a sufficient basis for judgment in a case of diabetes in which insulin treatment is employed. If in such a case the patient happens to have a low renal threshold he may continue to eliminate sugar even in the presence of hypoglycæmia. Without a glucose tolerance test such a condition might be interpreted as due to insufficient insulin dosage, and the insulin treatment would be continued and the dosage might even be increased, a course which would inevitably lead to hyperinsulinism.

BRADYTOCIA

A Study Based on Five Hundred Cases in the Chicago Lying-In Hospital[1]

By D. A. HORNER, M.D., F.A.C.S., Chicago

BRADYTOCIA is a term seldom used in obstetrics but it fits in well with the words eutocia and dystocia. Like its companions it is of Greek origin and literally translated means slow parturition—slow not referring to the frequency of the pains but slow from the standpoint of accomplishment.

Bradytocia is more inclusive than dystocia, which denotes only pathological labor. Eutocia means normal labor. Either of these may be of short or long duration. Bradytocia applies to all of those long drawn out, tedious cases extending beyond average time limits whether accompanied by dystocia or not. De Lee specifies these limits as 20 hours for primiparæ and 14 hours for multiparæ; Williams specifies even less time.

One often hears of unusually prolonged cases of labor extending from several days to a week or more. We have all seen cases in which labor actually started and for some unknown reason stopped after a few hours and started over again after a few days or even weeks of quiescence.

Differentiation must be made between actual labor and so-called false labor pains and pains having their origin outside the generative tract. Even after long observation of the patient one may be deceived. It is often difficult to denote the time of transition from false into real labor pains. Progressive dilatation plus contractions are the only criteria.

For purposes of study, 500 bona fide cases of bradytocia were selected from the records of the Chicago Lying-In Hospital in the order of their occurrence. They occurred in the practices of the attending staff, visiting physicians, and house service. The statistical tables resulting, while rather numerous, are self-explanatory.

During the time covered, 4,521 deliveries occurred at the hospital, thereby the 500 cases of bradytocia show an incidence of over 10 per cent. Practically 1 case in each 10 was of prolonged labor. We found that 60 per cent were American born, 15 per cent Russian, while the remaining 25 per cent were distributed among 20 other nationalities.

It is interesting to note that bradytocia occurs most frequently in primiparæ in the earlier childbearing years; 400 of the 500 cases were included in the years between 19 and 30. Unmixed nationalities, as a rule, do not suffer this complication as regularly as hybrids; the Russian Jewess in this country is a frequent sufferer. From various sources I learn that whites encounter it more often than black, yellow, or red races. It is a product of the big city with its many conveniences and easy living, yet it does occur in farming and small communities but with relative infrequency. Previous bradytocia is often an index of what to expect in subsequent labors. Social status does not play an important rôle; rich and poor alike may experience it. Some obstetricians rarely have protracted cases, others encounter them with monotonous regularity; still others may be influenced by their ability to recognize impending bradytocia and by their capacity to avert it by suitable operative management. Errors of judgment would, of course, creep in here and cloud the statistics.

No one exciting etiological factor has been discovered but the condition can be attributed to a combination of influences, chief among which are the early rupture of the bag of waters (dry labor), over-term pregnancy, malpositions, mal-presentations, and primary inertia. The fact that bradytocia occurs most commonly in the early reproductive years may denote that a deficiency of innervation or tone exists in the uterine musculature of these young gravidæ which prevents them from going into labor at the proper time or does not permit a proper functioning of that organ when labor does begin. This is emphasized repeatedly by other concomitant deficiencies in the body.

[1] Read before the Chicago Gynecological Society, June 18, 1926. (For discussion see p. 281.)

TABLE I.—AGE*

Age	Cases	Brady-tocia	Per Cent
13	1	0	0
14	0	0	0
15	1	0	0
16	26	4	15
17	45	11	24
18	85	12	14
19	147	26	11
20	236	36	15
21	222	47	21
22	273	36	13
23	312	28	9
24	340	50	15
25	307	34	11
26	328	30	9
27	270	37	14
28	297	29	10
29	249	20	8
30	277	29	10
31	176	11	6
32	183	11	6
33	128	9	7
34	116	4	3
35	128	12	9
36	93	6	6
37	66	4	6
38	70	6	8
39	47	2	4
40	45	3	6
41	17	...	..
42	20	2	10
43	12	1	..
44	2	...	..
45	2	...	..
Total	4,521	500	

*In Table I we present a comparison of ages in a total of 4,521 deliveries which included 500 cases of bradytocia.

Relaxation of the abdominal walls, cicatrices in the generative tract, malformations of the uterus, torsion, polyhydramnios, and abdominal tumors may be responsible.

The accompanying tables reveal the frequency of bradytocia as compared with the general run of cases.

TABLE II.—PARITY

Para	Cases	Brady-tocia	Per Cent
I	2,117	403	14
II	1,237	53	4
III	579	22	4
IV	282	8	3
V	110	6	5
VI	63	2	3
VII	43	4	10
VIII	30	1	3
IX	20	1	5
X	15	0	0
XI	8	0	0
XII	7	0	0
XIII	6	0	0
XIV	3	0	0
XXII	1	0	0
Total	4,521	500	

I have made a clinical division and subdivision of the 500 cases, using only the outstanding feature as an index for its position in Table III.

TABLE III.—CLINICAL DIVISION AND SUBDIVISION AS TO OUTSTANDING FEATURE

	Cases	Per Cent
A. Powers deficient, disproportion present		
Primary inertia	96	19
Secondary inertia (dry labor)	89	20
Large baby	47	9
Malpresentation		
Transverse	2	0.4
Breech	5	1
Face	3	0.6
B. Powers efficient, disproportion present		
Malposition		
Occiput transverse	35	7
Occipitoposterior	73	14
Pelvis		
Justominor and flat pelvis	75	15
Flat	25	5
Combination	8	2
Soft parts	6	1
C. Combination of A and B, as in dystrophia, dystocia syndrome	36	7
Total	500	

CLINICAL COURSE

In the usual case of bradytocia the patient may enter the hospital with either slight or well established contractions. The bag of waters may or may not be ruptured, the cervix is as a rule partially effaced and somewhat dilated. In a case of primary inertia the hours pass with little change in the character of the pains. They may even subside or become irregular. In dry labor and in the other forms the tendency is for the contractions to become more frequent and painful at first, allowing the patient little opportunity for physical and mental rest and interfering with her desire to take the necessary nourishment. The pains sooner or later diminish sufficiently to allow her a fitful sleep which does not relieve her fatigue very much.

If this state continues, the pulse rate increases, the skin after 24 or 36 hours becomes drier; there is a characteristic odor to the breath; a discharge is present; sordes appear on the teeth and lips; the urine becomes concentrated and scanty and on laboratory examination shows the presence of albumin, ace-

tone, and diacetic acid. In short, the patient now presents the picture of physical exhaustion with acidosis. The temperature rises often to 100 or 101 or even more; the blood pressure, which has been running about normal may now be somewhat raised or if the second stage of labor has been reached may, without warning, suddenly bound to dangerous limits and not infrequently, just as delivery is imminent or accomplished, comes an unexpected convulsion or convulsions with coma. It is logical to assume that sometimes death may end this acute acidosis and toxæmia.

In this series not one patient was allowed to continue after the onset of symptoms of acidosis. The picture described above, of course, is to be modified in many ways according to the obstetrical and pathological conditions.

The 96 cases of primary inertia include those in which the pains were slight in character, far apart, and of short duration but nevertheless were real labor pains as evidenced by the slow but continued progress. This seems to be a rather large number to be considered primary but were so labeled because of the absence of any causes which would have included them under any other head, that is, no disproportion or malposition or malpresentation: just primarily deficient pains. The 89 cases of dry labor is in my opinion a relatively small number to have in such a formidable group as these 500.

I shall not attempt to go much into the details of the various subdivisions of my classification but wish to point out that the causes for most of the difficulties lie in the second group, chief among which are the small pelvis and posterior occipital position. In this group are considered those cases which are given the so-called test of labor; those borderline cases in which the disproportion is so great that other methods of delivery than that from below are seriously considered and yet the disproportion is not so great as to place them in the class for elective cæsarean section. The clinical course here is dependent upon no single element mentioned but is always based upon its relationship to the others; for example, a large baby may go through a large pelvis—but not one of normal size. Even a small baby in malposition will not go through a normal pelvis until the position has first been corrected and in neither case can a child come through if the rigidity of the soft parts cannot be overcome.

Bradytocia is the result of Nature's inability to overcome these deficiencies in a given length of time. Many hours of strong labor are often required to sufficiently mold a head through a pelvis. In transverse presentation and face persistently posterior, spontaneous delivery is as a rule, impossible without assistance no matter how long the labor may continue.

Harrar in a series of 8,360 recognized occiput posterior positions showed that 95 per cent of the patients were delivered spontaneously when given sufficient time. The time required for anterior rotation and delivery in a large number of these cases is usually prolonged well beyond normal time limits and brings them under the head of bradytocia. It would be interesting to know how many of Harrar's cases were bradytocia.

We have noted that most of the time in some cases is consumed in rotation without a proportionate amount of dilatation while in others rotation is very rapid after complete dilatation permits the head to descend to the pelvic floor and in still another small number of cases anterior rotation never occurs but all the time is consumed in the preparation of the soft parts with ultimate delivery as persistent occiput posterior.

In Group C are those cases in which are combinations of deficiencies in the powers, together with relative disproportion. Included among them is a number of labors occurring in a peculiarly characteristic group of patients who so plainly have dystocia that we at the Lying-In Hospital have given the signs the descriptive nomenclature "dystrophia dystocia syndrome."

In this type, the patient's difficulties begin before or shortly after marriage with rapidly increasing weight, menstrual irregularity, and sexual apathy. Pregnancy may be years in arriving. The physical markings are characteristic. She is usually of short stature and of stocky build, well rounded out with fat, has a relatively long torso and short thighs. There is a tendency to masculinity as evidenced by hair on the face and intermammary

TABLE IV.—DURATION OF LABOR. FIRST STAGE—FOUR-HOUR INTERVALS

First Stage Hours	Per Cent*	Cases
24	31	157
28	18	76
32	15	67
36	10	52
40	7	34
44	4	23
48	6	30
52	4	19
56	2	10
60		8
64		4
68		3
72		8
76		0
80		2
84		1
88		1
92		0
96		2
100		1
120		1
134		1
		500

*In 95 per cent of the cases the first stage lasted from 24 to 56 hours.

groove. The escutcheon often reaches the navel and has masculine shape. Her fingers are short and stubby with little difference in length between the second, third, and fourth digits. The forearm from the styloid process to the olecranon can be spanned by the average hand.

The bones of the pelvis are thick and heavy. The pubic arch is narrow as in the male pelvis. The vagina is often tight and shallow and the levatores often rigid. The pelvis appears to be filled with non-elastic tissues. Such women do not bear their pregnancies well because of many aches and pains throughout the entire body. They are subject to disturbances of all the endocrines and have a tendency to toxæmia and abortions. Their pregnancies frequently go over term and their babies become relatively large. The presenting part fails to engage before the onset of labor, which not infrequently begins after the rupture of the membranes.

Seldom is a first labor in this type spontaneously terminated without protracted suffering and extensive damage to mother and child.

In the series there occurred 69 postpartum hæmorrhages, 14 per cent, a rather small number. Uterine decompensation is to be expected.

The duration of labor in the 500 cases is shown in Tables IV and V.

TABLE V.—DURATION OF LABOR. SECOND STAGE—HALF HOUR INTERVALS

Second Stage Hours	Per Cent	Cases
0	14	69
½	17	88
1	22	113
1½	19	96
2	10	51
2½	7	35
3	4	19
3½	2	13
4		9
4½		4
5		1
5½		0
6		0
6½		0
7		0
7½		1
8		1
		500

DIAGNOSIS

The diagnosis of an impending bradytocia begins in the prenatal period. At the first examination one can form an opinion of what to expect by the patient's general physical construction, the pelvic anatomy and capacity, and during the later months of pregnancy, by fetometry.

The history of previous labors may be enlightening, as well as the character of the onset of labor, that is, its failure to gain impetus—the rupture of the bag of waters early in labor or even before it begins, figuratively speaking starting with the wrong foot first. The hours drag on with little change; the repeated rectal examination shows that neither descent nor effacement and dilatation are progressing normally. If the bag of waters is not ruptured but oligohydramnios exists, the hydrostatic dilating effect may be as inefficient as if the bag of waters were ruptured. In other words, the presenting part alone must do the dilating. Twelve hours of labor at most ought to show what to expect. Of course, the closer one approaches the normal time limits of labor without sufficient accomplishment the more certain one is that he is dealing with bradytocia.

PROGNOSIS

While every one of the 500 mothers left the hospital alive, the maternal morbidity was necessarily high. This is to be expected in

bradytocia and should not be held against the attendant. The long continued wear on the patient's power of resistance, the damage of oft-repeated examinations and manipulations reduce her chances of withstanding infection. Lastly, the *lapsus artis* of the accoucheur, when his own faculties are clouded and his body calls for rest, while inexcusable, is not to be held too seriously against him. In no branch of medicine is so much demanded of the physician and taken for granted by the laity as in the management of a slow labor. No general surgeon would be as severely condemned for a fatality as the obstetrician for an infected perineum. No surgeon has so much explaining to do as the one responsible for directing the entry of a new life into the world.

TABLE VI.—POST-PARTUM HÆMORRHAGE

		Cases
Frequency in series (13.8%)		69
Method of delivery		
Spontaneous	17	
Operative	52	69
Delivery of placenta		
Expressed	38	
Manual removal	31	69
Associated conditions		
Organic heart disease	11	
Hypertension	4	
Laceration	3	
Hyperthyroidism	1	
Inertia	50	69

Average duration of labor 40½ hours.
Average weight of baby 3,477 grams.
Treated with sedatives 219 (38 had post-partum hæmorrhage).
Not given sedatives 281 (31 had post-partum hæmorrhage).

TABLE VII.—SIZE OF CHILD*

Grams	Number
2000 to 2400	25
2500 to 2900	59
3000 to 3400	197
3500 to 3900	151
4000 to 4400	59
4500 to 4900	8
	499
Records unavailable on account of mutilation	4
	503
Twins	3
Total	500

*The average of ascertainable weights was 3,333 grams (7 pounds 5 ounces), 2 ounces below the normal average; 43 per cent plus were oversize, that is between 3,500 and 4,900 grams.

There is an essential mortality rate for mother and child in labor and puerperium. Bradytocia raises this rate and while in this series no mother lost her life there is no assurance that the next case may not be a fatal one. Figures are not at hand for the many cases occurring at large but it would not be amiss to attribute a certain percentage of the maternal deaths reported to the authorities under various non-obstetrical headings, as indirectly due to this condition.

Maternal invalidism is frequent as the clinical course would lead us to expect. Vigorous attempts at delivery may seriously damage both hard and soft parts. Loosened symphyses, a separated sacro-iliac joint, and a dislocated or fractured coccyx are not uncommon findings.

Lacerations of the pelvic fascia produce prolapsus uteri, cystocele, and rectocele; extensive tears of the cervix may render further childbearing impossible besides causing other more immediate complications. Injuries out of proportion to the force used in delivery frequently occur. The change in the tissues of the perineum and pelvis responsible for such damage is similar in character to what goes on in the rest of the body. "Blotting paper perineum" is an appropriate term. The tissues are altered by an accumulation of the end products of an extensive period of active metabolism. I have seen a third degree laceration produced at examination preparatory to delivery.

Every system in the body may show the effects of bradytocia: psychoses and plegias, total or partial blindness. The heart muscle and function of that organ are also capable of being severely damaged. Severe anæmias may last for years. The bladder and urethra may be involved, and the kidneys may show the effects of the strain.

As injuries are inevitable in the treatment of bradytocia, the big question in the treatment is one of keeping these damages to the minimum. Rupture of the uterus, post-partum hæmorrhage and puerperal infection are dangers constantly present.

The fetal mortality rate in this series, 5.8 per cent, can be considered relatively low. Most of the deaths were the result of vigorous operative measures which were followed by hæmorrhages occurring in the brain from

TABLE VIII.—MATERNAL STAY IN HOSPITALS

Days	Patients	Days	Patients
12	343	21	2
13	59	22	4
14	37	23	3
15	16	27	1
16	10	28	1
17	6	36	1
18	6	39	1
19	6	40	2
20	1	59	1
			500

Table VIII does not imply that all the patients left the hospital recovered.

ruptured tentorium, falx, and from hæmorrhage in the adrenals. Two babies were sacrificed.

Fetal injuries which need not necessarily kill the baby may handicap its future; Erb's paralysis, facial paralysis, fractures, hemiplegias, and dislocations are to be included.

TABLE IX.—BABIES

Left hospital in good condition	467
Left hospital in doubtful condition	7
Died before mother left hospital	16
Stillbirths	11
Craniotomies	2
	503
Twins	3
Total Cases	500

TREATMENT

In the treatment of bradytocia the axiom that "hindsight is better than foresight" holds true as in other branches of medicine.

The zero mortality rate in this series of cases speaks well for the methods employed, but there is much left to be desired. Each succeeding case of bradytocia seems to leave us in the same helpless situation. Maternity at best is a difficult task for the mother; waiting for the results of a so-called watchful expectancy may in years to come be regarded as obsolete. The tendency now is in this direction. Ways and means will be devised to prevent such horrors as a 3 day labor.

A beginning is seen in the education of the pregnant woman to report early at a clinic or to a private physician for a physical examination which would show her fitness or ability to bring children into the world. In this way it is possible to weed out for elective cæsarean sections a certain number which would undoubtedly fall in the bradytocia class. While hard and fast rules cannot be laid down for general application, a definite plan of action should be attempted in each case. Such a plan we should begin to formulate early in pregnancy and develop to complete maturity before the patient has spent many hours of useless labor.

Thorough familiarity with the patient's pelvis will reveal what to expect from this angle. The general make-up of the patient and her obstetrical history are indexes of the character of labors to follow.

It is hardly advisable to watch a pregnancy go beyond term and to allow a fetus to attain such a size that dystocia is inevitable. Induction of labor by recognized methods are indicated to overcome these important bradytocial factors.

Efforts to restrict the growth of the fetus by diet, hygiene, and exercise are more successful in improving the health of the patient and preparing her for her task than in keeping the child small. In the last 6 weeks it is necessary to caution her concerning exertions, injuries, and intercourse as causes for premature rupture of the bag of waters and dry labor.

Another measure we have found valuable is to perform carefully and under strict asepsis, internal pelvimetry on primiparæ who enter and remain in labor with the presenting part unengaged during a reasonable number of hours of good contractions. In this way another group can be removed from the bradytocia class by performing early sections.

A classical and universally accepted definition for "test of labor" must next be composed. At present any school attempting a definition of the test of labor meets open hostility from others. All that can be expected of a patient is to show what she can accomplish and not how much she can endure. With this in mind a keen obstetrician will boldly lift a patient out of the bradytocia class by operative measures which his sluggish, and sometimes stubborn confrére is compelled to employ many hours later when it is too late to expect good maternal results. Craniotomy on the living child does not add to one's reputation as an obstetrician, especially if he has managed the case from the beginning.

Of the 500 cases studied, 208, 42 per cent, were delivered spontaneously; figures which speak well for "watchful expectancy." The term implies more or less treatment as indications arise. These figures give an idea of even better results in the home where the temptation to operate is not as great as in hospitals.

The most important matters for consideration in bradytocia are preparatory to delivery of the child. When there is continued progress regardless of the time it takes, it is good policy not to interfere in any other way than to conserve the patient's strength by judicious feeding and administration of sedatives. Prevention of fatigue is essential.

Regulation of uterine contractions is dependent upon their character. In primary inertia, stimulation of uterine contractions is by no means an easy task. I shall enumerate a few methods which have been attempted in the 96 cases which occurred in our series: (1) hot bath; (2) hot enemata; (3) stripping the membranes from the cervix with gentle attempts at cervical dilatation; (4) vaginal tampons of (a) lysol pledgets, (b) boroglyceride pledgets; (5) metreurynter; (6) hydrostatic bag inserted in rectum; (7) rupture of membranes; (8) castor oil and quinine; (9) pituitrin in 1, 2, or 3 minim doses, repeated at half hour intervals if necessary.

It is obvious that this array of agents is too great. If there were one good reliable measure there would be no need to mention the others. I have purposely placed castor oil and quinine and pituitrin at the bottom of the list because of their dangers. Castor oil and quinine are generally considered devoid of danger, but those of us who have been accustomed to their use in the past now use them with almost as great reluctance as we use pituitrin which is now practically taboo at the hospital.

Tumultuous contractions or pains which keep the patient in a constant uproar demand sedatives. Our routine procedure in such instances is to administer morphine sulphate grains ¼ with 2, 3, or even 4, 2 cubic centimeter ampoules of 50 per cent magnesium sulphate, the latter at 20 minute or half hour intervals. When results are unsatisfactory we give the ether oil enema as advocated by Gwathmey. Since the almost routine administration of morphine and magnesium sulphate in my own practice, I have found a marked decrease in bradytocia. The same can be said of the house cases.

TABLE X.—TYPES OF OPERATION

Forceps	Cases
Low	114
Mid	98
High	22
Breech extraction	18
Version and extraction	17
Embryotomy	7
Cæsarean section (laparotrachelotomy)	16
Total operative deliveries	292
58 per cent.	
Total spontaneous deliveries	208
42 per cent.	
	500

Duehrssen's incisions were used in 48 cases.
Forceps were applied on aftercoming head in 10 cases.

Next we are concerned with securing complete cervical dilatation; this is accomplished easily in some instances—with difficulty in the majority of bradytocia cases. Our most reliable method is the metreurynter, but it is not unusual to find that when the bag is expelled through the cervix that organ contracts down again behind the bag. Manual dilatation signifies manual laceration which may be of formidable extent. In multiparæ manual dilatation is more successful. If manual dilatation in primipara is indicated we prefer Duehrssen's triple incisions. Extensive cervical dilatation which has remained stationary for more than 8 hours, demands treatment by incision when other measures have failed and contractions are moderately severe.

Dilatation complete, there is very little to be gained by waiting longer. With spontaneous dilatation not more than an hour, or an hour and a half, should be permitted to elapse after the onset of the second stage. A longer period than that is dangerous. It indicates dystocia of some sort which eventually must be terminated by operative means if one is to safeguard the life of the baby and its mother. Yet in Table V, I show 134 cases in the second stage from 2 to 8 hours without serious mishap.

The cervix out of the way, the end of labor is in sight.

If conditions point to the spontaneous delivery of the child, well and good; if not, we are confronted with the possibility of dealing

with any subject in the entire field of operative obstetrics.

CONCLUSIONS

Contrary to previous opinion, bradytocia occurs more frequently in young than in old primiparæ. Large babies do not play such an important rôle as we formerly believed.

Prophylaxis, by weeding out the unfit in pregnancy and early labor, is all important. Cæsarean section is easier on such individuals than long drawn out labors with serious operations in the end. When the decision has been made to deliver from below, true watchful expectancy yields excellent results.

It is essential that we all agree on what constitutes the so-called "test of labor."

The active treatment, as it stands today, is to prevent fatigue by shortening the first stage of labor. We fully appreciate the advantages of sedatives administered early. Manual dilatation, except in a few cases, should be discarded for bags or Duehrssen incisions. It is not advisable to allow more than 2 hours for the second stage.

The correction of malpositions and presentations with the delivery of the child include almost every phase of operative obstetrics.

Bradytocia is a destructive process in women. Practically every system in the body may feel its effects. The greatest dangers are from rupture of the uterus, post-partum hæmorrhage, and puerperal sepsis. Therefore every effort must be made to offset these complications by properly evaluating the contractions of the uterus, and by gentleness in all manipulations. Conservation of blood can be accomplished by early placental removal and tamponade. The diminished resistance of the patient invites infection, therefore fanatical asepsis is not too much to expect of oneself, assistants. and armamentarium.

TUMORS OF THE GASSERIAN GANGLION

With the Report of Two Cases of Extracranial Carcinoma Infiltrating the Ganglion by Direct Extension Through the Maxillary Division[1]

By MAX MINOR PEET, M.D., F.A.C.S., Ann Arbor, Michigan

TUMORS of the gasserian ganglion, both primary and secondary, have attracted considerable attention because of their apparent rarity and the intense suffering occasioned by the growth. Primary tumors, that is, those actually arising from the ganglion, are extremely rare. The majority of writers, however, include under this category the tumors, particularly the endotheliomata, which originate in the dural sheath of the ganglion. The first of the truly primary growths was studied in 1836 by R. W. Smith and described in his monograph on *Neuroma* published in 1849. From the description and illustration made at the autopsy, the tumor appears to have been a neuroma, although Hutchinson classifies it as a sarcoma. This case report has been apparently overlooked by most authors and is not included in the various statistical studies subsequently published. The first secondary tumor reported was a carcinoma described by Gunzburger in 1848. Hellsten (4) in 1914 collected 23 cases of primary and secondary ganglion tumors and Frazier (3), in a careful review of the literature up to 1918, found 40 cases of ganglion tumor and added 3 of his own. To this list should be added 2 early cases, 1 reported by Smith and 1 by Little (9), and the following more recent cases: Hutchinson (6), chondrosarcoma 1, carcinoma 1; Percy (12), probable endothelioma 1; Shelden (14), endothelioma 3, glioma 1; Cushing (1, 2), endothelioma 5, osteochondroma 1, epithelioma 1, carcinoma 1, adamantinoma 1; Henneberg (5), lymphosarcoma 1; Omodei-Zorini (11), neuroblastoma 1; a total of 63 tumors which definitely involved the gasserian ganglion with the production of excruciating pain in the face. The case of Henneberg is especially interesting as the tumor proved to be a primary lymphosarcoma of the small intestine with metastases to both gasserian ganglions. No other metastases were found at necropsy. There are doubtless other cases recorded which should be included in this tabulation. Some might include the rare cases of acoustic or cerebellopontine angle tumors involving the sensory root and thereby simulating direct involvement of the ganglion. The more frequent cases of tumors in the middle fossa, especially gliomata and sarcomata, which at autopsy are found to have involved the ganglion and even to have extended along the second and third branches into their foramina of exit but without resulting pain, should without doubt be included if some of those in the list of 63 cases are to remain classified as gasserian ganglion tumors.

The first operation on a gasserian tumor was performed by Krogius (8) in 1895. Five years later, Keen (7) reported the first operation for a ganglion tumor in this country. With the advances in trigeminal technique, other operators exposed ganglion tumors but with very little success. Sachs (13), in a paper published in 1917, reviewed 8 operative cases, and added a personal case and a rather complete bibliography. The following year, Frazier reported the first completely successful extirpation of a ganglion tumor. Hofmeister, Berg, Frazier, and E. Sachs had previously obtained partial success with temporary relief of pain. In the cases of Hofmeister and Sachs the patients had return of pain in the face and both died, the former because of an irremovable growth found at operation, the latter from local recurrence, although at the first operation the excision had seemed complete. Berg's patient died from abdominal metastases and Frazier's former case from continued growth of the tumor. His last case proved to be an endothelioma arising from the dural sheath of the ganglion. There was complete relief of pain and no evidence of recurrence after 15 months. Of the 43 cases compiled by Frazier, only 13 had been oper-

[1] From the Department of Surgery, University of Michigan.

ated upon, 12 with exposure of the tumor, and of these, only 3 were apparently removable at operation and only 1 of the 3 was completely excised with no recurrence or metastasis. Several of the recent cases have had either successful tumor extirpation or satisfactory palliative avulsion of the sensory root.

Tumors in any part of the face, jaw, accessory sinuses and nasopharynx may involve the extracranial branches of the fifth nerve, but the 2 cases here reported appear to be the only examples of malignant infiltration of the gasserian ganglion by extension through these branches of an extracranial neoplasm. The usual involvement of the ganglion seems to be by continuity through an erosion of the floor of the middle fossa immediately beneath the gasserian. Involvement of the peripheral branches is not rare, as shown by New (10) and by the more detailed study of Woltman (15). The latter found 11 cases of fifth nerve involvement in 25 patients with malignant tumors in the nasopharynx showing cranial nerve symptoms. While the ganglion was probably invaded in some of these cases, apparently in none was it proven by operation or necropsy; and in his review of 44 cases of nervous system involvement from nasopharyngeal tumors, only 5 implicated the fifth nerve and only 1 involved the gasserian ganglion. The latter was by direct continuity. Woltman states: "It is the peripheral portion of the nerves which is most often caught in the tumor growths but the gasserian ganglion has been known to be involved." Cushing (1), from his experience with neuralgias of tumor origin, divides the cases into four groups: "(1) The tumors in the cerebellopontile recess which press upon the trigeminal root; (2) those involving the ganglion by direct pressure from above; (3) those arising in the pterygoid fossa or in the temporal bone, which press against the ganglion from below; and (4) those arising from the envelopes of the ganglion itself."

A fifth group should now be added, comprising those in which the ganglion is secondarily involved by the inward extension of an extracranial neoplasm through a peripheral branch of the fifth nerve. A sixth group, largely of academic interest, includes the metastatic tumors of the ganglion.

Our 2 cases appear unique in the literature but more frequent efforts to relieve the terrible suffering of patients with nasal neoplasms involving the maxillary branch of the fifth nerve will undoubtedly show the condition to be more frequent.

CASE 1. Mrs. L. A., 34918, age 66, gave a past history unimportant for present consideration. The present trouble started 6 months before examination with pain in the left cheek and left lower jaw. She first noticed a spot at the left nasolabial fold which she thought was a "cold sore." This area was painful but quickly became numb to touch. A "burning, tingling" sensation was then felt in the same area. This gradually spread over the left cheek and left lower jaw. At the same time the entire left side of the face seemed swollen. The accessory sinuses were thought to be infected and were accordingly drained, but whether infection was actually found is uncertain. The pain continued unabated, increasing in severity after the first month and has been especially acute the past 6 weeks.

She has a constant burning sensation in the left cheek and upper lip, left side of the tongue and in the entire left lower jaw and lip. Superimposed on this constant, severe, burning pain are attacks of acute, shooting, lancinating pains in the same distribution. The pains are of great intensity but last individually only a fraction of a second. Several, however, may occur in rapid succession. They seem of special severity in the left side of the nose, tongue, and roof of the mouth but the pains extend to the middle of the lips, to the left ear and onto the neck below the jaw. At times, she has pain behind the left ear and a feeling of pressure over the vertex. The supra-orbital region has never been involved. Vision has not been affected, but closing the left eye seemed sometimes to lessen the attacks of pain. Memory is slightly impaired; other mental functions appear normal.

Physical and neurological examination: The patient is poorly nourished and shows senile changes in the skin. The sense of smell is apparently normal. Extra-ocular movements are normal. There is no nystagmus. Pupils are equal and react to light and in accommodation. Vision is good when corrected with glasses. There is almost complete anæsthesia of the left side of the face in the distribution of the second and third branches of the fifth nerve. Both tactile and pain sense are lost except in very small, isolated spots. All sensations are normal in the distribution of the first branch of the left gasserian ganglion. Sensation is normal on the right side of the face.

There is paralysis of the left masseter, temporal, and pterygoid muscles. The right motor fifth is normal. No seventh nerve palsy on either side. Right acoustic is normal. Has been deaf in left ear for 30 years. Pharyngeal muscle movements are normal.

Sternocleidomastoid and trapezius muscles show no weakness nor atrophy. Tongue protrudes straight. No tremor nor atrophy.

Biceps and triceps reflexes are slightly diminished. Patellar and Achilles reflexes are normal.

A few small cervical glands are palpable. Moderate arteriosclerosis is evident in the vessels of the extremities. Repeated careful examinations of the nose, nasopharynx, and accessory sinuses by Doctor Canfield failed to show any evidence of malignancy. The physical examination was essentially negative. X-ray examination of the head and accessory sinuses showed no abnormalities except a loss of outline of the lower border of the left orbit and cloudiness of the left ethmoid cells. This may indicate malignant disease in the ethmoid region but no evidence was found by direct examination.

A diagnosis of tumor involving the gasserian ganglion was made and operation advised. The question whether the tumor was primary in the ganglion or secondary to a more distant malignant process could not be decided. Operation with section of the sensory root was indicated in either case as the pain was of the greatest intensity, resembling attacks of trigeminal neuralgia except for the constant, burning pain previously mentioned.

Operation. December 19, 1922. The usual approach to the gasserian ganglion was made. The dura was elevated without difficulty. Extending outward and slightly forward from the foramen spinosum was a small, irregular defect in the bone, filled level with a rather soft, granular appearing tissue. This defect was about 1 centimeter long by 3 millimeters wide. The foramen spinosum was plugged with a wooden peg and the middle meningeal artery divided. The foramen ovale was just in front of and medial to the foramen spinosum and showed no erosion. The dura was separated from the mandibular branch at the cleavage line just above the foramen ovale. The dura was then stripped upward and inward, exposing the greater portion of the ganglion and the region of the sensory root. The dissection was also carried forward, exposing the entire maxillary branch to the foramen rotundum. No abnormality of the dura was noted and it was elevated from the ganglion without difficulty. The gasserian ganglion appeared two to three times its natural thickness, but was not enlarged in other directions. The greatest enlargement was in the second branch through which the malignant process had invaded the ganglion. The fibrous appearance so typical of the normal ganglion was grossly emphasized, the separate fibers appearing enormously enlarged, standing out like small strings. The dura propria was incised over the sensory root and down onto the ganglion. The sensory root appeared normal. The upper third of the ganglion, to the beginning of the sensory root was rather dark purplish in color, the lower two-thirds appeared whiter than normal. (Fig. 1.) The sensory root was divided and the greater portion of the gasserian ganglion removed. It was quite avascular and none of the usual troublesome bleeding from the vessels entering the under side of the ganglion was encountered.

Healing was by primary union and the convalescence uneventful. There was complete anæsthesia in the distribution of the left fifth nerve and complete relief from the attacks of excruciating pain. A deep pain, described more as a slight, dull ache, was felt at times in the region of the antrum. This was probably due to the malignant process in the bone as we know that deep pressure is preserved after section of the sensory root.

The pathological examination of the upper portion of the ganglion showed ganglion cells and a number of hyaline and sand bodies, the whole infiltrated diffusely with a malignant neoplasm in small nests and cords. The lower (whiter portion) of the ganglion showed more ganglion cells and sand bodies with the same malignant infiltration. The tissue removed from the bone defect just lateral to the foramen spinosum, but which was in no way connected with the gasserian ganglion or its branches, showed connective tissue with large nests of cells of epithelial type. The pathological diagnosis was "medullary squamous cell carcinoma without cornification."

X-ray therapy was administered for several months. The deep bone ache persisted but caused little discomfort. Several weeks after operation, a hard, rounded swelling appeared on the face just posterior to the antrum and gradually increased in size although it caused no pain, the entire area being anæsthetic. This tumor was probably the lateral extension of the original carcinoma of the ethmoid cells which had evidently perforated into the sphenomaxillary fossa involving the second branch of the fifth nerve and later had penetrated the soft tissue posterior to the antrum and maxillary bone.

CASE 2. Mrs. S. P., 127906, age 54, gave as chief complaint, sharp, shooting pains in the right side of the face. Her father had died of carcinoma of the mouth.

Past history. She has had some headaches for the past 6 years, always localized in the supra-orbital region. Three months ago, she had a severe attack of frontal sinusitis with severe pain in the supra-orbital region but she distinguished this pain from her present complaint, describing the former as a constant, dull pain, totally unlike the severe lancinating pains which later appeared in the side of the face. The frontal sinusitis continued until relieved by an operation through the nose 3 weeks ago.

She has had no visual disturbances, dizziness or vomiting. Hearing is good in both ears. All teeth were extracted 10 years ago.

The present trouble started 8 weeks ago with excruciating pains recurring many times a day in the right cheek and upper lip. The pain is described as sharp, stinging, and shooting up or down from the region of the upper lip and back over the right side of the face. The attacks of pain are intermit-

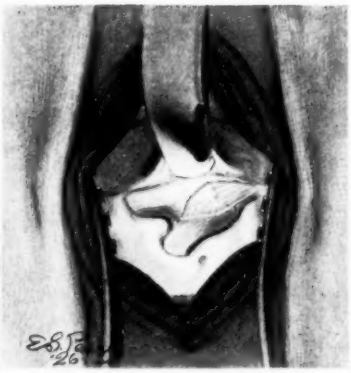


Fig. 1. Case 1. Showing enlargement of the gasserian ganglion, especially of the second branch. Insert shows purplish area in posterior portion of ganglion.

Fig. 2. Case 2. Showing marked enlargement of gasserian ganglion with much thickening of second branch. Third branch is normal.

tent, come on suddenly with full intensity and are immediately gone. Several flashes of pain may occur in quick succession, followed by a quiescent period of indefinite length. The pain never radiates to the lower jaw, neck, ear nor above the eye and is not brought on by eating, talking, or touching the face. Between the attacks of pain she has noticed a "numb burning" sensation, chiefly in the upper lip and at the side of the nose. There is also a paræsthesia in the second division of the right fifth nerve, described as a sensation of "warm and cold" and a "crawling feeling."

Neurological examination. The senses of smell and taste are not impaired. Vision is good. Fundus examination is negative. Pupils react to light and accommodation. Extra-ocular movements are normal with no nystagmus. Light touch is practically lost and pain from pin point greatly diminished on right upper lip from the angle of the mouth nearly to the midline and from the lip margin to the nose. (Fig. 3.) The masseter, pterygoids, and temporal muscles on each side contract normally. There is no facial paralysis. Hearing is good in both ears. The soft palate rises in the midline. Sternocleidomastoid and trapezius muscles are normal on both sides. The tongue protrudes straight with no tremor or atrophy present. There is no ataxia or intention tremor. Supra-orbital, biceps, triceps, patellar, and Achilles reflexes are prompt and equal.

There is a slight deviation of the nasal septum to the left, with polypoid middle turbinate on the right and slight mucopurulent discharge on this side. The right antrum responds to transillumination poorly. The tonsils are small and septic. The nasopharyngeal examination is negative.

Roentgenological examination showed normal frontal sinuses, some haziness of the ethmoid cells and a definite opacity of right antrum.

A diagnosis of tumor involvement of the second branch of the right fifth nerve was made on the findings of anæsthesia coupled with severe attacks of typical trigeminal pain and a burning aching sensation in the intervals.

Alcoholic injection of the second branch gave no relief although total anæsthesia was obtained. In fact, the patient stated that the pain was even worse after this treatment. Section of the sensory root of the gasserian ganglion, therefore, was advised.

Operation. June 13, 1925, under ethylene anæsthesia, the usual temporal muscle-splitting incision was made. The dura was elevated easily and the foramen spinosum exposed, plugged with a wooden peg, and the middle meningeal artery divided. The foramen ovale with the third branch was then exposed and the dura elevated from the entire ganglion with the exception of the ophthalmic division. The ganglion appeared thicker and whiter than normal and the second branch, from the ganglion to the foramen rotundum, was much enlarged, decidedly round instead of flattened and very hard. (Fig. 3.) The sensory root was divided and the distal portion of the root, together with the adjacent posterior part of the ganglion, was removed for pathological study. The motor root was preserved. There was no evidence of malignant infiltration of the dura and no involvement of the floor of the middle fossa. The tumor had evidently reached the ganglion by direct extension through the second branch of the ganglion which had been infiltrated extracranially.

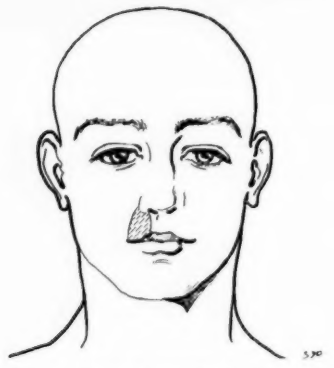


Fig. 3. Case 2. Area of anæsthesia and hypo-algesia before operation.

Convalescence was rapid and the severe, stabbing pains were completely relieved. A peculiar dull pain, impossible of description, was still felt in the right side of the head. Microscopical examination of the sensory root and posterior portion of the ganglion showed no pathological change.

She returned October 28, 1925, complaining of severe headaches, especially on the right side. There had been no return of the neuralgia-like pains in the face. There was a partial paralysis of the levator of the right eyelid, the patient opening the eye with difficulty, and then as a result of action of the frontalis more than of the levator. This lagophthalmos was considered due to intracranial extension of the neoplasm. The fundus showed no change and vision was unimpaired. Deep X-ray treatments were continued.

On February 6, 1926, she returned because the headaches were more severe and almost constant. She could not describe the pain other than to say it was dull and extended to the vertex and from deep behind the eye to the posterior parietal region. Aspirin gave some relief and at times codeine was required to obtain sleep. There was very marked protrusion of the right antral region and in this area was felt a dull ache. There was complete ptosis of the right eyelid. The right eye was turned outward and all movements of the eyeball were lost. The pupil was dilated, irregular, and did not react to light or accommodation. Fundus examination was negative in both eyes. Extra-ocular movements of the left eye were normal. The anæsthesia of the right fifth nerve was complete (from section of the sensory root). The motor branches of both fifth nerves were normal. No paralysis of the other cranial nerves was present.

The tumor of the right antrum had now invaded the alveolar process and mucous membrane, appearing in the mouth as two hard, flattened elevations with slight ulceration. A biopsy showed the growth to be squamous-celled carcinoma. Her condition had not changed 2 months later.

The first patient had practically complete relief, the slight dull ache causing little actual discomfort. The second, however, complained later of severe distress somewhat in the nature of a headache. Both were completely relieved of the excruciating pains which had brought them to the hospital. Such operative relief is well worth while, even though it be purely palliative. Death from the carcinoma may be long delayed and in the meantime the patient may be made relatively comfortable without the use of opiates. In many ways, section of the sensory root of the gasserian ganglion in such cases is comparable with chordotomy to relieve the pain of inoperable growths in the lower half of the body.

The symptoms of gasserian ganglion tumor or of involvement of a main branch are so clear cut that no confusion should occur except possibly in the very early stages of the disease. Then it might be mistaken in some instances for trigeminal neuralgia. As a rule, however, the pain associated with a tumor is much more continuous, and, of much more diagnostic importance, anæsthetic areas in the distribution of at least one branch soon appear. Such loss of sensation is never found in true trigeminal neuralgia. I have seen it in only one other condition, which occurred in a case showing an inflammatory process in the ganglion. Although in the cases with tumor, attacks of pain may appear suddenly with the greatest violence and be typically described as shooting, lancinating, a knife thrust through the tissues, or like lightning, still between the attacks a more or less constant, dull ache or burning pain is frequently noticed. This is never found in the pure neuralgias.

The typical symptoms of tumor involvement of the gasserian are quite constant. Attacks of pain identical with those of tic douloureux may be the first intimation of trouble. Sometimes instead of major trigeminal pain there has been noted at first a burning or stinging sensation, or a sharp pain, not as severe as those occurring later. Attacks of excruciating pain soon develop, frequently with a marked increase in their intensity. Between the severe attacks, which always extend to the periphery of the branch involved, may be minor attacks and in addi-

tion, there is usually some constant burning or aching, often felt deep within the face. The very severe pain may shortly become almost continuous and is in some instances worse at night. At first only one branch is implicated, but the adjacent branch is soon involved. Very rarely the middle branch is the last affected. Even at the beginning of the painful attacks, the patient may have a subjective sensation of numbness, and comparatively early, areas of hypo-æsthesia or anæsthesia develop. There may be a preceding hyperæsthesia. With few exceptions, the attacks of pain are not instigated by eating, talking, or touching the face.

The motor branch of the fifth nerve is occasionally paralyzed. When this occurs, the diagnosis of tumor invasion of the ganglion or at least of its mandibular branch is at once evident. In trigeminal neuralgia, the motor root is never affected.

Sooner or later in the majority of cases, other cranial nerves are involved, particularly the third and sixth. The results following section of the sensory root of the fifth are, however, so satisfactory that the operation should be undertaken even with a multiplicity of cranial nerve palsies, although their presence generally indicates an inoperable condition from the standpoint of complete tumor eradication.

SUMMARY

A brief review of the reported gasserian ganglion tumors, both primary and secondary is given. The majority of these tumors originate in the dural sheath of the ganglion or involve the ganglion by direct pressure from contiguous regions in the middle fossa or petrous portion of the temporal bone. A few are primary nasopharyngeal tumors which erode the floor of the middle fossa, and infiltrate the ganglion by direct continuity. Rarely the lesion is metastatic from a distant focus. Two cases are presented in which the gasserian ganglion is infiltrated by extension through the maxillary branch, the carcinoma originating in the antrum or ethmoid region.

Involvement of the gasserian ganglion should be considered established when pains of great intensity resembling those of trigeminal neuralgia are associated with areas of anæsthesia in the face. Paralysis of the motor branch of the fifth nerve or of other cranial nerves is a rather common confirmatory finding.

Although the majority of gasserian ganglion tumors are irremovable, section of the sensory root should be performed to relieve the terrible pain which is an almost constant symptom.

BIBLIOGRAPHY

1. Cushing, Harvey. The major trigeminal neuralgias and their surgical treatment based on experiences with 332 gasserian operations. Am. J. M. Sc., 1920, clx, 157.
2. Idem. The meningiomas. Brain, 1922, xlv, 282.
3. Frazier, Charles H. An operable tumor involving the gasserian ganglion. Am. J. M. Sc., 1918, clvi, 483.
4. Hellsten, Magnus. Ein Fall von Ganglion Gasseri-Tumor. Deutsche Ztschr. f. Nervenh., 1914, lii, 290.
5. Henneberg, R. Doppelseitige Trigeminusneuralgie Infolge von Symphom Beider Gasserschen Ganglien. Klin. Wchnschr., 1922, i, 2479.
6. Hutchinson, J. On Facial Neuralgia and Its Treatment. New York: William Wood & Company, 1919, p. 75.
7. Keen, W. W. Endothelioma of the gasserian ganglion; two successive resections of the ganglion, first by the extradural (Hartley-Krause) operation, and, secondly, by an intradural operation. J. Am. M. Ass., 1900, xxxiv, 1026.
8. Krogius, Ali. Om operativ behandlund of tumoren i fossa media cranii. Rev. de chir., 1896, xvi, 434.
9. Little, T. E. Intracranial tumor; glioma of the fifth nerve. Dublin J. M. Sc., 1873, lv, 94.
10. New, Gordon B. Syndrome of malignant tumors of the nasopharynx. J. Am. M. Ass., 1922, lxxix, 10.
11. Omodei-Zorini, A. Tumore del ganglio di Gasser. Gior. d. r. Accad. di med. di Torino, 1923, xxix, 68. Neuro blastoma maligno bilaterale del ganglio di Gasser, ibid., 158.
12. Percy, Nelson M. Tumor of the gasserian ganglion. Surg. Clin., Chicago, 1918, ii, 569.
13. Sachs, Ernest. Tumors of the gasserian ganglion. Ann. Surg., 1917, lxvi, 152.
14. Shelden, Walter D. Tumors involving the gasserian ganglion. J. Am. M. Ass., 1921, lxxvii, 700.
15. Woltman, Henry W. Malignant tumors of the nasopharynx with involvement of the nervous system. Arch. Neurol. & Psychiat., 1922, viii, 412.

THE CLINICAL IMPORTANCE OF BUCK'S AND COLLES' FASCIÆ[1]

By MILEY B. WESSON, M.D., San Francisco

COLLES' fascia and Buck's fascia should be of interest to all surgeons because of the part they play in controlling the direction and extent of peri-urethral inflammation, or urinary extravasation incident to rupture of the urethra. Such conditions are among the most complicated that come to the surgeon's attention and the treatment calls for the rarest skill and judgment, as indicated by the all too frequent fatalities that follow unscientific therapy. Clinical reports in the literature depict a variety of methods of treating urinary extravasation; and emphasis is laid upon the bad prognosis and the necessity in most cases of radical and mutilating surgery. However, details as to the paths and the rapidity of the extravasation are practically always lacking.

Five cases of limited extravasation are here reported: a ruptured varicocele with a hæmatocele that was confined within Colles' fascia, and 4 cases of localized extravasation that conformed to Buck's description as a "circumscribed, hard, prominent swelling of the size of a Madeira nut in the anterior part of the scrotum covering and closely embracing the urethra and also extending on either side around the root of the penis in the form of an indurated flattened band."

The term "fascia" is a confusing one. Technically, it is defined as a sheath or band of tissue which invests and connects the muscles. Practically all fasciæ are only compressed layers of the fibrous connective tissue everywhere present and split in various ways by different dissectors. Embryologically, fascia consists merely of a condensation of mesenchymal tissue which occurs subsequent to the formation of a structure. A lack of liaison between the dissecting room, where fascia is demonstrated on a hardened body as a single dense sheath, and the surgical amphitheater where it appears as thin layers bound together with connective tissue partitions is responsible for most of our inaccurate anatomical knowledge and bizarre perineal surgery. Such terms as Buck's fascia (1), Colles' fascia (2), Denonvilliers' fascia (3), recto-urethralis muscle (4), and internal sphincter of the bladder (5), indicate to the surgeon clinical entities, but to the anatomist they are not definite structures. Colles' fascia (Fig. 1) has been more or less indefinitely depicted in the textbooks of descriptive anatomy but, unfortunately, no two descriptions are alike. Buck's fascia has been ignored by the anatomical textbooks and is mentioned only in textbooks of urology, the original reference, until recently, apparently having been overlooked (6).

Gurdon Buck, Jr., in 1848, treated a patient at the New York Hospital for a localized extravasation of urine, which occurred at the root of the penis. The rupture of the urethra had taken place within the sheath of the corpus cavernosum and the inflammatory swelling consequent to the extravasation of urine was confined to these narrow limits. As a result he reported the discovery of a distinct membranous sheath (Fig. 2) investing the penis and forming a continuation of the suspensory ligament above and the perineal fascia below and laterally to form one continuous membrane with the sheath enclosing the corpus cavernosum in its cavity, and embracing the corpus spongiosum between two layers one of which passes above and the other below. The excavated base of the glands adheres inseparably to the outer surface of the sheath, which by means of its under-surface caps the summit of the corpus cavernosum. Posteriorly, from the suspensory ligament, membranous septa pass between the accelerator muscles in the middle and the erectors on either side to join the triangular ligament, thus forming three distinct, independent sheaths that are confounded anteriorly with the common sheath investing the corpus cavernosum.

Abraham Colles, an Irish surgeon, noticed that following a rupture of the posterior urethra the effusion of urine formed a tumor in the perineum that did not suppurate there because of the unyielding nature of the fascia,

[1] Presented before the Section on Urology, California Medical Association, Oakland, California, April 28, 1926.

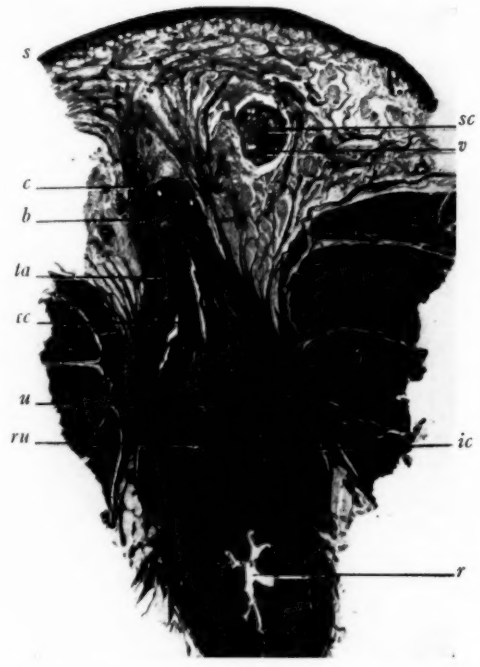


Fig. 1. Section through pelvis of term fetus, showing Colles' fascia and Buck's fascia. *s*, Skin; *cc*, corpora cavernosa; *la*, tunica albuginea; *b*, Buck's fascia; *sc*, spermatic cord; *v*, vas deferens; *r*, rectum; *u*, urethra; *c*, Colles' fascia; *ic*, ischio-cavernosus muscle; *ru*, recto-urethralis muscle. Embryo, Carnegie Institute 2409, slide 166. (× 2.)

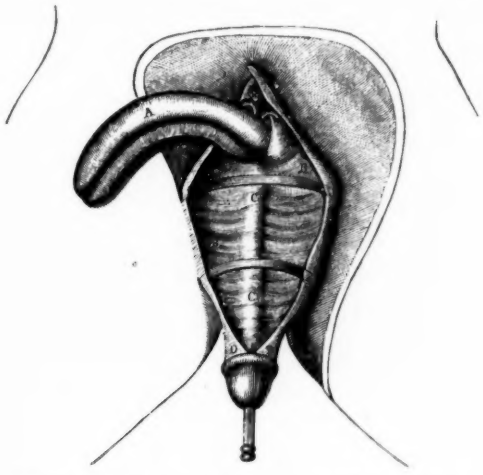


Fig. 2. Buck's fascia. A dissection of the sheath of the penis, showing; *A*, the corpus cavernosum, enucleated from the sheath; *B*, the sheath, split up through the suspensory ligament, of which it is a continuation; *C*, the relations of the sheath to the corpus spongiosum urethræ, one layer of which passes above, the other below it; *D*, its relation to the glans penis, to which the sheath adheres inseparably by its outer surface, while by its inner surface it caps the corpus cavernosum; *E*, the dorsal arteries, veins and nerves raised with the sheath. (Buck.)

and that diffusion laterally toward the thighs was prevented by the close attachment of the fascia to the rami of the pubes and ischium, hence it passed into the loose tissue of the scrotum and there suppurated or passed up over the pubes. In 1811, he described this fascia as attached to the external layer of the triangular ligament and to the rami of the pubes. It runs around the dorsal aspect of the superficial transverse perineal muscles, then down and forward under the skin of the perineum and scrotum, forming the outermost fibrous sac of the testicle. Colles' fascia is continuous with the dartos muscle in the scrotum, anteriorly with Scarpa's fascia and the fascia lata, laterally with the superficial fascia of the gluteal region, and posteriorly with the circumanal fascia.

Three types of urinary extravasation (Fig. 3) are commonly encountered: (1) between the layers of Buck's fascia, (2) within the superficial perineal interspace, and (3) distal to the deep layer of the urogenital diaphragm.

If the rupture occurs anterior to the urogenital diaphragm, the penile fasciæ confine it and produce a circumscribed swelling. The septum of Buck's fascia usually protects the corpora cavernosa body from involvement, but if the opening is through the dorsum of the corpus spongiosum the tunica propria of the corpora cavernosa protect these bodies from invasion.

The common pathway, however, is ventral and the extravasation is confined temporarily within the superficial perineal interspace, but Colles' fascia with its dense partitions interposes an effective barrier and prevents the spread posteriorly to the ischiorectal fossa and laterally to the thighs. As a result, the tumefaction tends to pass from the perineum down to the scrotum and then up over the pubes. In early stages the extravasation is unilateral, later both sides of the scrotum, as well as the penis down to the coronary sulcus,

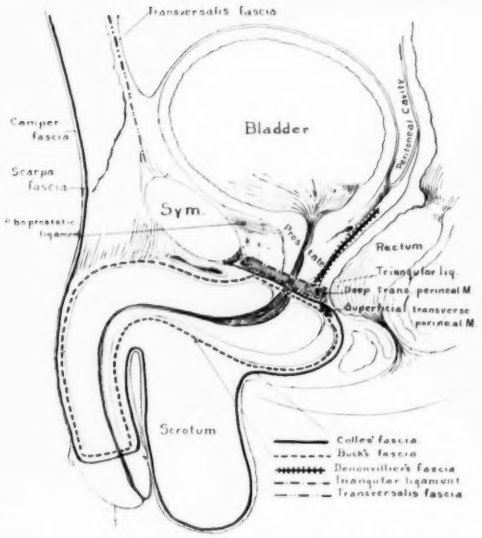


Fig. 3. Diagram of fascia of urogenital region concerned in urinary extravasation.

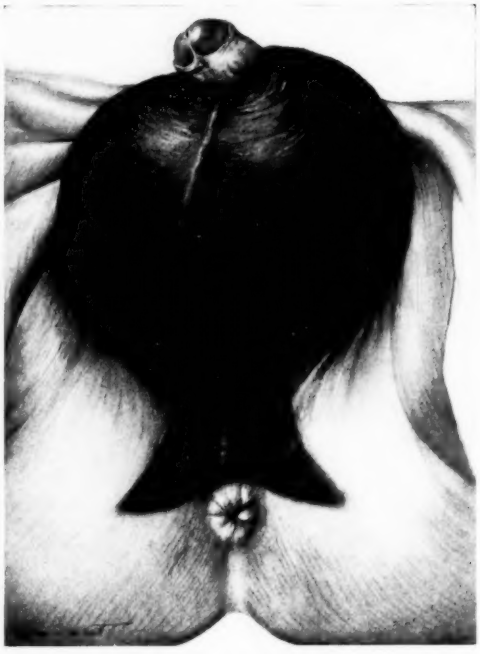


Fig. 4. Colles' fascia outlined by hæmorrhage from ruptured varicocele (Case 1).

are involved and the fluid may even pass up beneath Scarpa's fascia on the abdomen as far as the axilla.

If the rupture occurs distal to the urogenital diaphragm, the extravasation is held forward by Denonvillier's fascia. By dissecting up the peritoneum from the bladder the urine passes into the space of Retzius, and may extend posteriorly to the diaphragm and eventually even pass through the inguinal rings and appear on the abdomen.

The appended brief case reports demonstrate the clinical value of Buck's and Colles' fasciæ.

CASE 1. *Hæmatocele within Colles' fascia.* R. E., age 24, was seen on June 8, 1925, because of an enlarged purple penis and scrotum, and a diagnosis of strangulated inguinal hernia. Two days before this man, who works in a planing mill, ran a board 12 feet long, 3 feet wide and 3 inches thick through a sander; he then carried the board around to put it through a second time and as he dropped it he struck himself in the left groin. The board was carried parallel to the ground, one end being balanced against his waist. There was no discomfort at the time of the accident but on the following morning the scrotum was enlarged and both penis and scrotum were purple (Fig. 4). I made a diagnosis of a rupture of one of the veins of the left pampiniform plexus (later he admitted the presence of a varicocele on that side) and advised operation to evacuate the blood clots and possibly ligate the torn vessel. This was refused so the treatment consisted of rest in bed, elevation of the scrotum, and continuous application of ice bags. There was never any urinary disturbances. The diagrams (Fig. 5) demonstrate the gradual filling of Colles' fascia. On June 20, the hæmorrhage had entirely absorbed from the right side but in the upper part of the left was a circumscribed hard mass below which could be felt the testis. Inasmuch as this did not diminish in size after several days' waiting, it was opened with a stab wound and about 100 cubic centimeters of blood clots evacuated. On July 3, a mass again having formed and remaining stationary in size, it was tapped with a hydrocele trocar and 30 cubic centimeters of grumous fluid removed, with complete recovery. At present the patient is in perfect health and there is no evidence that he was ever injured.

External trauma ruptured one of the small veins in the pampiniform plexus of a varicocele. This caused a slow ooze which gradually extended to the uttermost limits of Colles' fascia, outlining in a very spectacular way this membrane.

CASE 2. *Abscess of gland of Littrê with urinary extravasation confined within Buck's fascia.* D. W.,

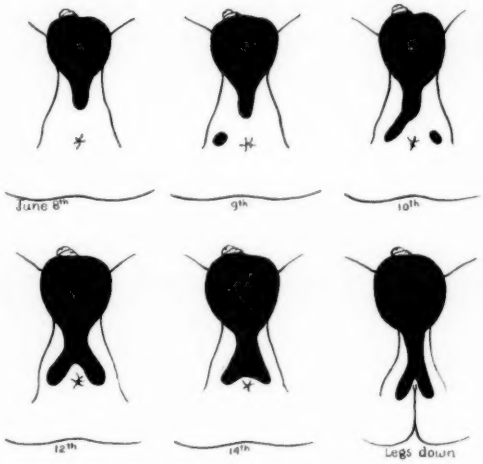


Fig. 5. The gradual filling of Colles' fascia; this did not take place as would be expected from the bulb outward but rather from the attachments of the tranverse perineal muscles inward as indicated by the Figures 2 and 3 (Case 1).

Fig. 6. Abscess confined within Buck's fascia; evacuated by means of intra-urethral cautery incision (Case 2).

age 24, referred by Dr. E. K. Johnstone on June 5, 1925, because of a swelling at the base of the penis. There was a history of an uncomplicated gonorrhœa in 1921, since which time the patient had married and had two healthy children. For several months he had noticed a small kernel about the size of a pea attached to the bulb in the penoscrotal region. Three weeks previous he was exposed extra-maritally and 7 days afterward developed gonorrhœa. A week later the kernel became enlarged.

Examination. The penis was cone-shaped, there being a large swelling at the base (Fig. 6) which apparently surrounded the organ. The tissues appeared tense and the classical signs of inflammation—tumor, dolor, calor, and rubor—were present. With the finger pressed into the scrotum, the posterior part of the mass could be felt and was definitely rounded and did not extend deep into the perineum. There was no urethral discharge but urine voided in three glasses was cloudy.

Operation. An endoscope was passed into the posterior urethra and gradually withdrawn until the opening was directly over the most prominent part of the swelling, this being supported by the hand. A small cautery blade was then passed down the endoscope and a free incision made. With the opening of the abscess there was a free flow of thick pus. By means of an endoscopic aspirator the cavity was washed clean and then with a Young's utricle syringe 5 per cent mercurochrome was injected into the cavity. The patient returned to his hotel and remained in bed with a hot water bottle over the mass. He reported the following day that at least one-half a teacup of pus had run out.

Treatment consisted of bladder irrigations of mercurochrome 1:1000 twice a day. After the irrigation the pouch bulged out with the solution and the patient by squeezing the shaft of the penis could squirt the water from the urethra a distance of several feet. The cavity was then squeezed dry by external pressure and 5 per cent mercurochrome was injected into the urethra with a bulb syringe so as to fill the cavity with this drug. There were no complications except a low-grade epididymitis. The patient was discharged as cured on July 20.

May 4, 1926. F. S. Dillingham (Los Angeles) who has recently examined the man reports, "There is no stricture, it is difficult to find even the scar and the patient has no discomfort of any kind."

This was a case of a gland of Littré complicated by a localized urinary extravasation confined by Buck's fascia. The gland was apparently infected in 1921, and there was an acute exacerbation following a second Neisserian infection. Treatment by intra-urethral incision with cautery and free use of 5 per cent mercurochrome solution resulted in cure.

CASE 3. *Extravasation of urine within Buck's fascia following the use of a Kollmann dilator.* M. O., age 44, was referred on May 29, 1925. He complained of pain in the left lumbar region which radiated around the brim of the pelvis to the inguinal rings, indefinite suprapubic pain, severe backache, daily frequency of 1 to 3 hours, and marked hesitancy. He had been under more or less constant treatment for a prostatitis and seminal vesiculitis

Fig. 7. Abscess within Buck's fascia which caused the scrotum to appear trilobed (Case 2).

over a period of two years, and had not been a cooperative patient as he was not only intensely neurotic but understood very little English.

Examination. Urine was voided in three glasses; G-1 contained many shreds. It took the patient about 5 minutes to start the stream. Rectal examination showed a prostate slightly larger than normal, and indurated nodules throughout on deep palpation. The seminal vesicles were pulled downward and outward by adhesions. They contained many nodules and were exquisitely tender on deep palpation. The expressed secretion contained large clumps of pus. Cystoscopy showed a residual urine of 50 cubic centimeters, marked trabeculations, numerous small petechial hæmorrhages over the vault of the bladder (patient was receiving neosalvarsan for an old syphilis), an elevated trigone, and a very definite median bar. A punch operation was advised and the patient refused.

He was returned to his local physician who treated him at indefinite intervals with massage, dilatations, etc. On October 31, 1925, two days after the use of a Kollmann dilator, a mass appeared at the penoscrotal juncture. This did not surround the base of the penis but appeared to extend ventrally from the bulb (Fig. 7). The patient refused to allow his surgeon to incise the mass under novocain and instead came back to San Francisco. When he reported to me he had a temperature of 103 degrees F. and was sent to the Hospital. The following day an endoscope was passed, and the mass incised with a cautery. The temperature immediately dropped. Subsequent treatment consisted of bladder irrigations of dilute solutions of mercurochrome followed by intra-urethral injections of 5 per cent mercurochrome after the contents of the sac had been evacuated by squeezing. The abscess cavity rapidly disappeared and the perineum returned to its normal outline.

This was a case of localized extravasation within Buck's fascia following instrumentation. Cure followed intra-urethral incision by means of cautery and free use of mercurochrome locally.

Case 4. *Localized extravasation of urine which broke through Buck's fascia with the formation of a perineal fistula.* M. F. C., age 28, was first seen on December 15, 1925, with an acute gonorrhœal urethritis. He was treated routinely and although the organisms disappeared from the urethral discharge within 24 hours, the posterior urethra and prostate became involved and an abscess developed apparently in one of the glands of Littré deep in the bulb. A swelling could be felt at the root of the penis, but before this became of sufficient size to warrant an attempt to puncture it with a cautery through an endoscope, a slight area of redness was noticed at the right lower border of the anus. There was never any appreciable enlargement of the prostate or fullness of the rectum, but when pressure was made upon this reddened area mercurochrome, which had been used as a bladder irrigation, could be forced out of the urethra. As the patient was suffering no discomfort he continued at his work, using bladder irrigations and urethral injections of mercurochrome. On January 17, 1926, he noticed difficulty in voiding. Immediately a small fistula developed at the anal border through which there was a leakage of urine on voiding and following bladder irrigations.

Treatment. A free incision was made and it was found that the cavity was wholly superficial and did not invade the ischiorectal fossa. The fistula opened into the bulb immediately in front of the triangular ligament. Postoperative treatment consisted of bladder irrigations with 1:1000 mercurochrome followed by urethral injections of 5 per cent mercurochrome. The wound entirely healed and all symptoms had disappeared on March 2, 1926.

In this case an abscess of a gland of Littré was not confined within Buck's fascia but broke through at the junction of Buck's and Colles' fasciæ and passed below the ischiorectal fossa, reaching the skin at a level anterior to the triangular ligament.

Case 5. *Abscess within Buck's fascia following punch operation, with resultant urethral fistula and urinary incontinence.* M. G., age 45, was seen on April 20, because of a urethral fistula at the penoscrotal juncture. In December, 1925, he began to notice urinary frequency and in February he had to void every 30 minutes. A surgeon found that the bladder capacity was only 60 cubic centimeters but by hydraulic distention this was increased to 400 cubic centimeters. He was then cystoscoped and a large median bar found, and 200 cubic centimeters of residual urine. On April 5 a punch operation was performed. The No. 29 F. Young's punch was

passed with great difficulty because of the small meatus. The final cut was made with the shaft of the instrument partially exposed at the meatus. Apparently the punch slipped by the cut bar and caught in the membranous urethra so that when the final cut was made the external sphincter was divided and the lower partition of Buck's fascia was opened.

The convalescence was stormy, and among other complications there was an acute dilatation of the stomach and a paralytic ileus. At the end of 6 days a band-like swelling about 1 inch wide appeared at the penoscrotal juncture partially surrounding the urethra; the following day it spontaneously ruptured externally and discharged purulent urine. The catheter, which had been inserted with great difficulty because of the small urethra, was removed and it was then found that the patient had urinary incontinence.

The use of a large Young's punch in a small urethra resulted in urinary extravasation into Buck's fascia followed by formation of a fistula and temporary bladder incontinence.

SUMMARY

Urinary extravasation occurs when there is an actual break in the mucous membrane. Although it is commonly considered a complication occurring after rupture of the urethra by external violence, or peri-urethral abscess with stricture, it is not unusual to find it following the unsuccessful passage of a sound, a Young's punch, or a velvet-eye catheter on a stylet. A stylet should be used only with alpha-eye catheters since the point tends to slip through the eye of the ordinary catheter and penetrate the space of Retzius, the weakest portion of the urethra being the roof immediately behind the triangular ligament. When force is used in passing a sound a slight tear is often made in the wall of the urethra. This usually heals spontaneously, but if a solution of potassium permanganate is used afterward as an irrigation there is a slough and extravasation.

An abscess of a gland of Littré may be followed by urinary extravasation temporarily restricted to a localized portion of Buck's fascia. If evacuated by means of an external incision a fistula will generally result. The operation of choice is an intra-urethral incision made with a cautery through an endoscope and the most satisfactory irrigating solution is mercurochrome.

Buck's fascia, Colles' fascia, Denonvilliers' fascia, and the triangular ligament are considered impenetrable bulwarks but they cannot resist inflammatory processes; hence when extravasations are complicated by necrosis the fasciæ no longer act as barriers and the involvement follows unexpected paths. Extravasations will not spread if there is drainage, and necrosis can be prevented if sufficient 5 per cent mercurochrome is kept in contact with the tissues.

NOTE.—*A hæmatocele distending the penile portion of Colles' Fascia* was recently seen in consultation with Dr. George W. Pierce. W. L., age 22, complained of bilateral hernia and undescended testicles. On June 23, 1926, the left testicle was brought from above the internal ring to its proper place in the scrotum and the hernia was repaired. Three months later the right side was operated upon but, because of the shortness of the spermatic cord, the testicle was temporarily left immediately below the external ring. On November 2, a third operation placed the right testicle in the bottom of the scrotum. Hæmastasis was apparently perfect, but cutting through the scar tissue evidently interfered with the lymph drainage and permitted a delayed venous ooze.

Two days later the small scrotum was distended and the penis was almost as large, it being about 3 inches in diameter and correspondingly elongated, tense, and bluish black in color. However, the glans penis remained pink. The gradual filling of the Colles' fascia corresponded to the diagrams in Figure 5. The only treatment used was the constant application of ice bags and rest in bed. There was no evidence of infection and the incision remained tight except for a slight serous ooze of a few days' duration. Complete absorption of the extravasation took place within 3 weeks and without impairing the surgery done.

REFERENCES

1. BUCK, GURDON, JR. A new feature in the anatomical structure of the genito-urinary organs not hitherto described. Tr. Am. M. Ass., 1848, i, 367–372.
2. COLLES, ABRAHAM. A Treatise on Surgical Anatomy. Gilbert and Hodges, 1811, pp. 151–180.
3. DENONVILLIER, C. Anatomie du perinee. Bull. et mém. Soc. anat. de Par., 1836, xi, 105.
4. WESSON, M. B. The development and surgical importance of the recto-urethralis muscle and Denonvillier's fascia. J. Urol., 1922, viii, 339–359.
5. Idem. Anatomical, embryological, and physiological studies of the trigone and neck of the bladder. J. Urol., 1920, lv, 279–315.
6. Idem. Fasciæ of the urogenital triangle. J. Am. M. Ass., 1923, lxxxi, 2024–2029.

Fig. 2. The Horsley modification of the Billroth I operation. The stomach has been removed and the stump of the stomach is brought to the stump of the duodenum. The posterior walls of the duodenum and the stomach are exposed by the surgeon twisting the clamps. The lesser curvature of the stomach is approximated to the upper border of the duodenum. A series of interrupted mattress sutures is inserted but not tied until all of them have been placed.

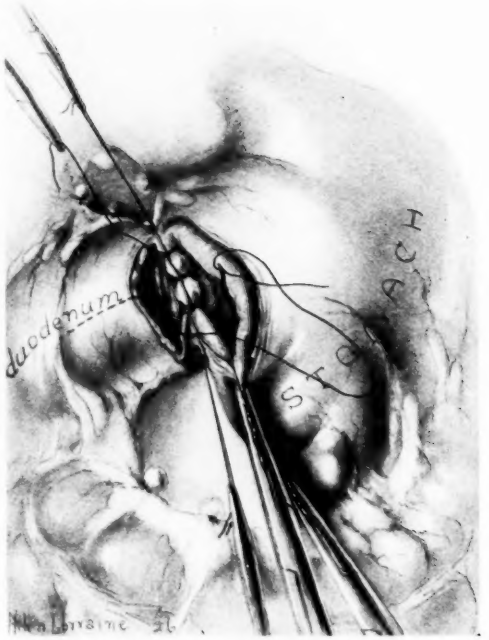


Fig. 3. The Horsley modification of the Billroth I operation. The row of mattress sutures has been inserted and tied, the clamps have been removed, and a continuous lockstitch has been begun to unite the posterior margin of the stump of the stomach to the posterior margin of the stump of the duodenum. The short end of the knot is left long. The dotted line shows where the incision in the anterior wall of the duodenum is to be made when the line of sutures has reached the lower border of the duodenum.

Partial Gastrectomy.—J. Shelton Horsley

CLINICAL SURGERY

FROM THE CLINIC OF DR. HORSLEY AT ST. ELIZABETH'S HOSPITAL, RICHMOND, VIRGINIA

PARTIAL GASTRECTOMY

By J. SHELTON HORSLEY, M.D., F.A.C.S., Richmond, Virginia

PARTIAL gastrectomy has become more prominent in the last few years, as Finsterer, Berg, and others have been advocating it almost as a routine operation for peptic ulcer of the stomach or duodenum. Naturally, partial gastrectomy has always been the operation for cancer of the stomach, but as so many cases of gastric cancer come to the surgeon too late for a radical operation the number of partial gastrectomies for this condition is somewhat limited.

Too much standardization of surgery of the stomach is often illogical. To be sure, one mutilating stomach operation may cure all gastric complaints, but often at the expense of much mutilation and a high mortality rate. All diseases about the foot, for instance, can probably be cured by an amputation above the knee, but certainly no one would approve of this procedure for such troubles as dislocations of the ankle, fracture of the bones of the foot, or ingrowing toe nails, while it might be indicated for certain malignancies or for gangrene.

It seems somewhat unfortunate to introduce an extensive radical operation as a standardized procedure for lesions that may vary greatly. For instance, a small peptic ulcer in the first part of the duodenum should not give the same indications for an extensive gastrectomy as cancer of the pyloric end of the stomach or as a large infiltrating peptic ulcer along the lesser curvature. There are distinct fields for different types of operations upon the stomach. With a limited ulcer in the first part of the duodenum without adhesions and without much infiltration, where the ulcer can be excised and the pyloric sphincter and the pyloric end of the stomach can be weakened in their spasm by an incision, the physiological pyloroplasty that I have been doing for some years seems to be indicated. The principle is the same as that of excising or cauterizing an ulcer within the grasp of the sphincter ani—a fissure *in ano*. The pathology is eradicated and the parts are given at least partial physiological rest by a weakening of the spastic muscles without materially altering physiological function. When such a small, well circumscribed ulcer has perforated the first part of the duodenum, this pyloroplasty appears strongly indicated instead of a gastro-enterostomy. It may also be used in a narrow contraction, though when there is marked stenosis or when extensive adhesions exist, the tissues have been so badly damaged by the disease that physiological function cannot be restored; consequently, some other type of procedure should be done, preferably a Finney pyloroplasty or a posterior gastro-enterostomy. When there is much infiltration around a peptic ulcer the sutures are not likely to hold and in such cases occlusion of the pylorus with a stout kangaroo tendon, tied just tightly enough to occlude the lumen without necrosis, and a posterior gastro-enterostomy is the method of choice.

In gastric peptic ulcer, I am more and more inclined to do a partial gastrectomy of the right half instead of midgastric or "sleeve" gastrectomy or a V-shaped excision of the ulcer. About a gastric ulcer there is frequently an area of diseased mucosa in which there may be a recurrence of the ulcer, particularly if sutures are applied. Besides, simple excision does not change the conditions that caused the ulcer in the first place, and a gastro-enterostomy added to the excision gives, if there is an open pylorus, an excellent opportunity for a jejunal ulcer which is usually even a worse condition than a gastric ulcer. If the ulcer is small and a local excision seems indicated, it is better to do the physiological type of pyloroplasty in order to give some physiological rest by overcoming the natural muscular resistance at the pylorus and so make it easier for the temporarily crippled stomach to empty itself.

In reconstruction operations it is best so to build up the tissues as to render the subsequent

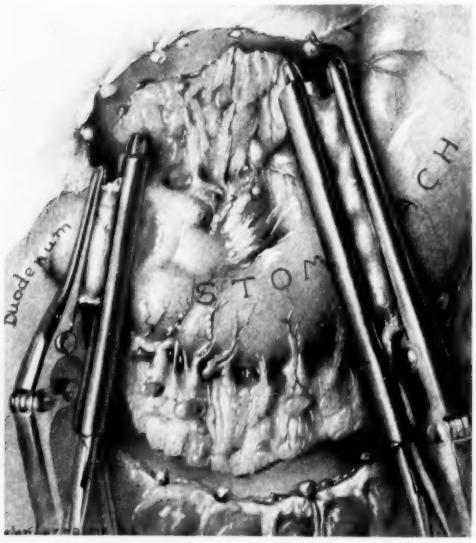


Fig. 1. The gastrohepatic omentum and the gastrocolic omentum have been divided and tied. The stomach is clamped ready to be removed.

physiological function as nearly normal as possible. For instance, in cholecystenterostomy it is found that the anastomosis should preferably be either in the duodenum where the bile naturally enters, or in the pyloric portion of the stomach where it regurgitates frequently, rather than in the colon where bacteria are numerous and ascending infection is certain and severe. So in reconstructing the stomach after excision it seems desirable to have the gastric contents empty into the duodenum if this be possible. If, on account of disease or adhesions about the duodenum, such a procedure is not practicable, the jejunum should be selected as close to the duodenum as possible and a type of modified Billroth II operation be done, bringing up the jejunum preferably through the transverse mesocolon.

For the last 3 years I have adopted a modification of the Billroth I operation that has given much satisfaction. In the original Billroth I operation, after the pyloric portion of the stomach was excised, the stump of the stomach was united to the stump of the duodenum along the greater curvature. The primary objection to this was that often leakage occurred along the upper border of the duodenum, where the line of sutures on the stump of the stomach split to encircle the duodenum. This was called the "deadly triangle," and leakage occurred so often at this point that the operation was for a while abandoned and the Billroth II, in which the stump of the stomach was closed and a posterior gastroenterostomy was done, was adopted.

There are two other objections to the original Billroth I. The most important portion of the stomach in regard to peristalsis is the lesser curvature, along which the stomach empties. The researches of Alvarez, Klein, and others have shown that apparently peristalsis is initiated from this region and that there are centers in this tissue, particularly near the œsophagus and at the incisura angularis, from which slight ripples proceed down to the body of the stomach where they become peristaltic contractions manifest on fluoroscopic examination, though the ripples may not be demonstrated by the X-ray. Then, too, if the thick stomach wall is united to the thin wall of the stump of the duodenum, in order to make the suturing secure, so much of the stomach must be infolded that obstruction may be produced. About 3 years ago such an obstruction occurred in one of my cases. A gastro-enterostomy was subsequently done, but the patient, who was an old man, eventually died of exhaustion. With the modification of the Billroth I operation that has been since adopted, this patient might have been saved.

The modifications that do away with these objections consist (1) in uniting the stomach to the duodenum so the lesser curvature of the stomach will be in alinement with the upper border of the duodenum, and (2) in flaring open the duodenum by making an incision about an inch or an inch and a half in its anterior wall. Thus, the physiological alinement of the lesser curvature is preserved and the danger of obstruction is obviated. Then, too, it is much easier to fold in redundant tissues along the lower border of the stomach where the stomach and surrounding mesentery and omentum are mobile than it would be along the upper border which is much less accessible.

If the partial gastrectomy is for cancer, and particularly if the patient is old, it may be readily done under local anæsthesia. Within the past year I have done this operation under local anæsthesia on two patients with gastric cancer, one 71 years old and the other 73. Both stood the operation well and are now in good health. In the old every possible precaution should be taken for safeguarding the patient. No drug that is sufficiently powerful to produce unconsciousness can be administered with impunity no matter how much safer it may be than the older anæsthetics. Even ethylene, which is probably as safe as any general anæsthetic, carries this

objection. In younger patients of more vigor, particularly if the operation is done for peptic ulcer, there is no objection to general anæsthesia. Often such an anæsthesia as ethylene may be combined with infiltration of the abdominal wall with novocain as practiced by Crile, which gives the effect of a mild general anæsthetic with relaxation of the abdominal wall by the injection of novocain.

The technique of this operation is practically identical whether it is done for cancer or ulcer, or under local or general anæsthesia. About an hour or two before the operation, the stomach should be thoroughly washed out with salt solution or with a weak soda solution. If local anæsthesia is employed a ½ of one per cent novocain solution to which has been added about two drops of the usual adrenalin solution to the ounce is used, in freshly prepared Ringer's solution. After opening the abdomen we infiltrate the parietal peritoneum for a distance of several inches around the wound, and then rather extensively inject the gastrohepatic omentum, the tissues just above and below the duodenum, and the retroperitoneal tissues along the base of the mesocolon. The needle is inserted not too deeply for fear of injuring a vein, but well beneath the peritoneum. If fully carried out these injections make the operation almost free from pain.

An incision is made through the inner portion of the right rectus muscle extending from just below the ensiform cartilage downward to about the level of the navel. If examination of the stomach and surrounding tissues shows partial gastrectomy to be advisable, the gastrohepatic omentum is divided. The gastric vessels along the lesser curvature at the point of proposed division of the stomach are doubly clamped with Ochsner forceps and divided. The stomach is lifted up and the lesser peritoneal cavity is gently packed with moist gauze. The gastrocolic omentum is incised and the vessels along the greater curvature are doubly clamped with Ochsner forceps and divided. These points should be carefully selected as they indicate the line of division of the stomach. The gastric vessels along the upper border of the pylorus and duodenum are doubly clamped and divided. The gastrocolic omentum is divided in sections. When the pylorus is approached along the greater curvature, care must be taken to avoid injury to the transverse mesocolon or to the head of the pancreas. The stomach is lifted up, and the first part of the duodenum freed posteriorly for about an inch. All the clamped vessels are secured by tying them with catgut. I use plain catgut, and in the larger

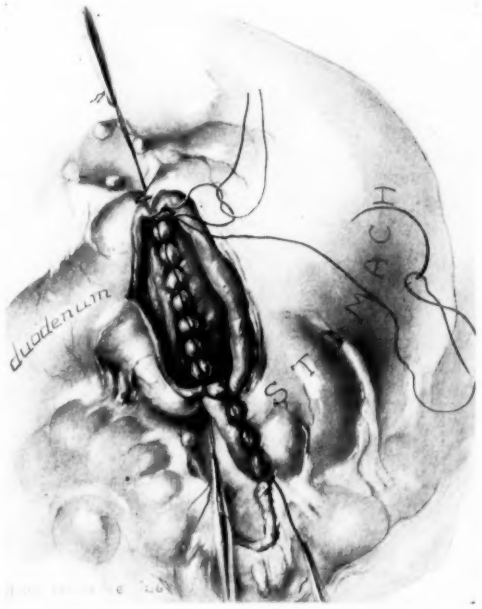


Fig. 4. The Horsley modification of the Billroth I operation. The posterior row of sutures has been continued, the posterior margin of the stump of the stomach united to the posterior margin of the stump of the duodenum, and the suture carried over the redundant portion of the stump of the stomach and terminated at the lower border. The anterior row of sutures is begun in a manner similar to that for the beginning of the posterior row of sutures. The short end from the anterior row of sutures is tied to the short end from the posterior row of sutures, in this manner making greater security at this point.

vessels transfix the tissues around them with catgut in a needle and usually apply to these two ligatures. The ligatures at the two distal points on the upper border and on the lower border are left long for markers. This leaves all the bleeding controlled, the lesser peritoneal cavity packed with moist gauze, and the right half of the stomach suspended only by attachment to the cardiac portion and to the duodenum. If the stomach has been washed out in the preliminary preparation, it should be comparatively flat. A long Payr clamp is placed across the body of the stomach at the point of the proposed line of division. Close to this another Payr clamp or a soft bladed forceps is placed. In the first part of the duodenum close to the pylorus, with enough stump of the duodenum to make the suturing satisfactory, a small Payr clamp or, better still, one of the clamps devised by Barr of Nashville, Tennessee, is placed,

and a second Barr clamp is adjusted close to this (Fig. 1). The duodenum is divided between these two clamps with the electric cautery, and the stomach is severed between the two Payr clamps with the electric cautery. In placing the Payr clamps on the body of the stomach, the upper point of the Payr clamp, where there is a small pin that fits into a socket, should be made to grasp the tissues at the lesser curvature and not project beyond the lesser curvature, else the stomach may slip from the grasp of the Payr clamp at this point and so cause leakage.

After a sufficient amount of the stomach has been removed, a method of reconstruction must then be considered. By running the hand under the cardiac stump of the stomach and severing any restraining bands, particularly along the gastrohepatic omentum, we may mobilize the stomach in most instances so as to reach the stump of the duodenum without tension, even if as much as half of the stomach has been removed. The stump of the stomach is brought over to the stump of the duodenum. The clamps are twisted somewhat so as to make the under surface of the stomach and duodenum approximate each other. Interrupted mattress sutures of No. oo tanned catgut are inserted, the first along the lesser curvature of the stomach and so placed as to make it in line with the upper border of the duodenum. These sutures are inserted between the posterior walls of the stomach and the duodenum but are not tied until all of them have been placed. Then they are tied snugly. The ends of the upper and of the lower suture are left long as markers (Fig. 2).

After the surrounding packing off of the stomach is revised, the Payr clamp is removed from the stump of the stomach and the lower portion of this stump is grasped with Ochsner forceps. At the upper portion where the walls have stuck together because of the Payr clamp, they are pulled apart and with a suction apparatus any accumulated gas and liquid are removed. The stump of the duodenum is similarly treated. Any bleeding vessels that may occur either in the stump of the stomach or the duodenum, are clamped when they show up after the Payr or the Barr clamp is removed. A suture of No. 1 tanned catgut is begun by passing the suture from within the stump of the stomach at the lesser curvature and going through the upper border of the stump of the duodenum from without inward. This is tied four or five times and the short end is clamped. This suture is carried down as a continuous lockstitch and is hæmostatic as well as approximating. It approximates the posterior margin of the stump of the stomach to the posterior margin of the stump of the duodenum (Fig. 3).

When the lower border of the duodenum is reached, an incision of an inch to an inch and a half is made into the anterior surface of the duodenum. The incision is made at this stage of the operation because if made earlier the relative alinement of the lesser curvature of the stomach and the upper border of the duodenum would not be so accurate. After they have been fastened by sutures, however, their relations cannot be disturbed and the flaring open of the duodenum will result in additional sutures along the lower border. The lockstitch is then continued as far as the flared-open posterior margin of the stump of the duodenum will permit. If the stomach is small, frequently all of the stump of the stomach can be directly united to the flared-open duodenum, but in most cases this is not possible and the suturing is then continued onto the redundant portion of the gastric stump, merely whipping over its margins. Another suture of the same material is begun, starting at the lesser curvature like the preceding suture, and going from within outward on the stomach and from without inward on the duodenum. The short end of this suture is tied to the short end of the preceding suture. In this way there is less likelihood of leakage here (Fig. 4). The suture is inserted once or twice from within and then is converted into a baseball stitch, uniting the anterior margin of the stump of the stomach to the anterior margin of the stump of the duodenum. The baseball stitch goes from without inward on each side, or else from within outward on each side. Either procedure produces the same results. It is applied snugly for, as with the posterior suture, it is a hæmostatic stitch (Fig. 5).

There is no occasion for cutting off the crushed ends of the stump of the stomach or of the duodenum. Halsted and Mall showed in their experiments that the sutured margins of bowel always slough off, and as the crushed end will prevent bleeding and as the sutured margin will slough off anyway because the suture is hæmostatic and cuts off circulation, removing a strip of tissue that will be included in the suture and will naturally have to separate as a result of this inclusion is quite useless.

The suture is carried down anteriorly and is terminated at the lower border of the duodenum. A pursestring suture of No. oo tanned catgut is applied at the lower border of the duodenum, beginning at the duodenum and going around the lower end of the stump of the stomach posteriorly

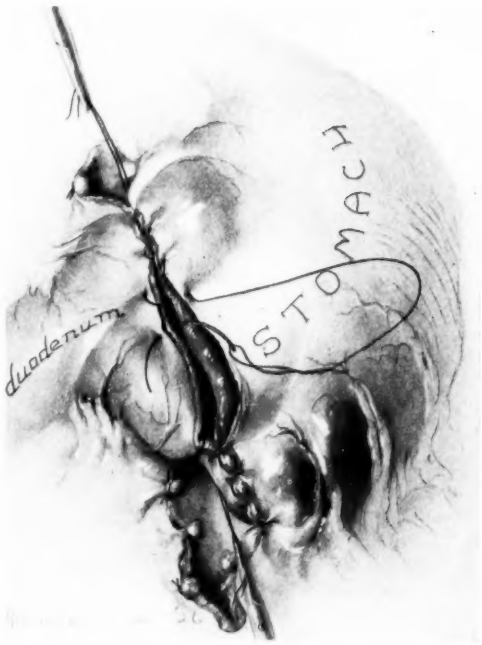


Fig. 5. The Horsley modification of the Billroth I operation. The anterior row of sutures is then continued down as a baseball stitch, and is terminated at the lower border of the duodenum.

Fig. 6. The Horsley modification of the Billroth I operation. The redundant portion of the stump of the stomach is surrounded by a pursestring suture of tanned catgut which, when tied, inverts this portion of the stomach as a teat. This suture is continued anteriorly as a right angle continuous suture, and buries the row of baseball sutures. Sometimes if the stomach is small, the stump of the stomach can be sutured to the flared-open duodenum without any redundancy.

and returning anteriorly. This is tied as the teat consisting of this redundant part of the stump is inverted (Fig. 6). The suture is then continued anteriorly as a right angle continuous suture, the other anterior row thus being buried. The suture is terminated at the upper border. A mattress suture of the same material is also placed at the lesser curvature, and should include the ligated stumps of the gastrohepatic omentum. This adds an additional protection. At the lower border an interrupted suture of No. 00 tanned catgut is placed, and catches some adjacent peritoneal covered fat so as to reinforce the suture line at this point. If desired, this peritoneal covered fat can often be carried up on the anterior surface of the suture line in order to reinforce it, though this does not always seem necessary. Certainly, however, there should be protection with the peritoneal covered fat along the lower border.

The wound is closed in the usual way without drainage.

With this operation a portion of the stomach which measured 23.5 centimeters along the greater curvature has been removed. If so much of the stomach has to be removed as to make it seem impossible to approximate the stump of the stomach to the stump of the duodenum without too much tension, it will be best to close the duodenum and do the Hofmeister modification of the Billroth II, which consists of closing the upper portion of the stump of the stomach and uniting its lower part to the jejunum retrocolically, after the manner of a gastro-enterostomy. While peristalsis occurs in the right two-thirds of the stomach, the cardiac end contracts tonically, so there is not the same indication for an opening along the lesser curvature when two-thirds of the stomach has been removed as when a lesser portion has been resected.

After this operation which I have described, the convalescence is remarkably satisfactory. The stomach seems to empty better than it does after

a lesser operation such as pyloroplasty or gastroenterostomy. We make a practice of washing out the stomach about 6 hours after any stomach operation to see if there is bleeding and to empty the stomach contents. If there is no bleeding this gastric lavage is repeated every 6 hours. We have never found more than 6 ounces of retained material after this operation, except on one occasion when there were 10 ounces. The patient is given water, about a half ounce an hour for the first day and after that the amount is somewhat increased. No food is administered until about the third or fourth day after operation.

If necessary intravenous glucose solution may be given with much advantage. This is often also used in preparing the patient for operation, giving about 1,000 or 1,500 cubic centimeters of 10 per cent glucose solution in Ringer's solution. The Ringer's solution should be made with freshly distilled water and the glucose solution added. If the water is freshly distilled, usually no reaction occurs. This therapy of continuous intravenous injection was first introduced by Matas of New Orleans. Instead of the drop method we use a long, slender, burette-like container by which the flow is fairly accurately estimated. Unless the patient is in shock, the solution is given at the rate of about 250 to 150 cubic centimeters an hour, though at first more can be administered. In this way the patient is not only prevented from being dehydrated but is given sufficient carbohydrates to tide him over the first few days. It is a mistake to give food too early after a stomach operation.

Careful supervision of the diet is essential after all gastric surgery, and for weeks or months after the operation it should be done by a competent internist. This in no way means that the operation is unsuccessful any more than would the wearing of a splint after the correct setting of a fracture reflect upon the accuracy or effectiveness of the reduction. When any operation is done upon the stomach, naturally the stomach is crippled for a while and until it recovers its full tone no more burden should be placed upon it than is essential to maintain sufficient nutrition.

During the last 3 years I have done fifteen operations according to this technique. Four of them have been for cancer. In one case the cancer was extensive and the stomach was slightly adherent to the pancreas. After the stomach was removed, a small superficial mass in the pancreas was excised with the cautery. It proved to be inflammatory, however, and not malignant. Peritonitis followed the operation and opened the raw surface of the pancreas to an inflammation which resulted fatally. With that exception there has been no death in the series, though the operation has been done for gastric cancer upon a patient 68 years of age who had an aortic stenosis, upon a patient of 71, and upon one 74 years of age. In the operations for peptic ulcer there has been no mortality.

FROM THE CLINIC OF THE CHICAGO LYING-IN HOSPITAL AND DISPENSARY

FORCEPS DELIVERY

By EDWARD L. CORNELL, S.B., M.D., F.A.C.S., Chicago

IN this short discussion the indications for low and midplane forceps will not be taken up. Certain conditions, however, which should be observed before instrumental extraction of the fetus is attempted, are considered.

1. The cervix should be fully dilated, or it should be easily dilatable manually or by means of Duehrssen's incisions. One should never attempt a forceps delivery if the cervix is not dilated at least 9 centimeters; to do so would court disaster.

2. The bag of waters must be ruptured before the forceps are applied.

3. The baby should be alive or have recently died (within 5 minutes). It is safer, especially in a primipara, to do a craniotomy on a dead baby. In multipara with the perineum badly lacerated and relaxed, it occasionally is permissible to do a forceps operation on a dead baby.

4. The head should be engaged.

5. The mother should be in good condition so that a general anæsthetic is not contra-indicated. One should never wait until the patient is thoroughly exhausted before attempting delivery, since the mother may go into shock. If the baby's head is allowed to remain on the perineum too long, brain hæmorrhage may result, which may lead to the infant's death immediately after birth or within a few days. One should not test the patient's endurance for suffering.

6. The pelvis should be large enough to permit the passage of the child.

The second stage of labor should not last over 1½ hours without definite signs of progress and seldom over 2½ hours when progress has been made. This means then that the mother and baby should be carefully watched throughout the second stage of labor. The mother's pulse and heart should be observed at least every 10 minutes, and the fetal heart tones counted every 5 to 10 minutes in the early part of the second stage and every 2 to 5 minutes in the last. Occult prolapse of the cord, small abruptio placentæ, etc., are too frequently overlooked unless this is done. The easiest way is to use the head stethoscope. By its use, one does not depend on assistants to locate the heart tones, to adjust the stethoscope, or to judge the quality of the fetal heart tones; one is master of the situation.

When operation is decided upon, the patient is placed on the operating table and prepared as follows: a sterile flat bedpan is put under the patient's buttocks. The legs are drawn up and the knees widely separated. A nurse, who has thoroughly scrubbed her hands and wears sterile rubber gloves, washes the lower abdomen, pubic area, inner surfaces of the thighs and vulva, in the order mentioned, using cotton pledgets, sterile green soap and water. This is followed by 1 per cent lysol solution. The area is dried with cotton and 50 per cent tincture of iodine is sprayed over the entire area, after which a sterile towel is placed on the abdomen and one under the buttocks after the bedpan is removed. The nurse then removes her gloves, puts on a sterile gown and new gloves, and sets up the operating table.

The patient is anæsthetized with any of the general anæsthetics except chloroform. Ether is the anæsthetic preferred at the Chicago Lying-in Hospital. Lately ethylene has been employed, being given by an expert anæsthetist. I believe, however, that ethylene causes the tissues to bleed more readily. If plenty of help is available, it is better to have the legs held by assistants, rather than to place them in stirrups. The patient is draped with a folded sterile sheet under the buttocks and one over each leg and leg holder. The abdomen is protected by a large heavy towel folded once, thus providing two thicknesses. The patient is then catheterized.

To catheterize with the least chance of infection, the following technique should be employed. The labia are widely separated with the first and second fingers of the left hand and are kept separated until the catheter is removed. Then the urethra is wiped downward, with the right hand, once only with each pledget of cotton soaked in ½ per cent lysol solution, four or more pledgets being used. The catheter is inserted in such a fashion that it touches nothing but the urethra on the way in. When the urine begins to flow the catheter should be left *in situ* without further manipulation. The continual insertion or withdrawal of the catheter during the emptying of the bladder invites infection. It is impossible to clean the vaginal orifice of all bacteria, and one should be satisfied to insert the catheter once

only far enough to draw urine and let it alone until the water ceases to flow. Then the catheter can be slowly withdrawn until the bladder is empty.

A careful vaginal examination is then made, two fingers only being used in a primipara or a multipara with a tight vaginal orifice. If more than two fingers are used the perineum should be stretched by ironing out, green soap being used as the lubricant, or by doing an episiotomy. If four fingers or the whole hand is inserted through the unprepared vaginal orifice, visible or invisible tears may result. The average operator's hand is at least 9.5 centimeters wide across the knuckles and 11 centimeters, including the thumb—many hands are 10 and 12 centimeters. The average fetal head is not much larger than this. Personally, the author gently irons out the perineum and does a left sided mediolateral episiotomy in all primipara who have full term babies and in all multipara delivered previously by him. He has been able to demonstrate to his own satisfaction that this procedure gives far better results as to the perineum. Visiting physicians who have seen the work agree with him.

For purposes of description the technique of the application of forceps is divided into that for low and mid-forceps. High forceps operations are not performed because of the greatly increased fetal mortality and the severe maternal lacerations which follow its use. A version and extraction usually give better results.

In low forceps cases, the head is usually found in anterior position, that is, the occiput is directly under the pubis. It may be 15 or 20 degrees to one or the other side. After the position is determined with the two finger examination, the perineum is ironed out and an episiotomy done. Usually the incision is carried through the urogenital septum to the sheath of fascia covering the levator ani muscle. If the baby's head is large or the outlet contracted, the incision is carried through the sheath of the muscle and the muscle may also be cut. The forceps are applied at this time.

In midplane forceps cases, the occiput may be found in any position in the pelvis. More often it is in one or the other transverse, and not infrequently, in the posterior position. It is the latter position which causes most of the difficulty in the delivery by forceps. I am not an advocate of the use of the forceps to rotate the head in transverse or posterior positions. Therefore, my technique in those cases is as follows (for purposes of description the left position will be used; in right positions the reverse directions would hold).

The right hand is inserted into the vagina, and the back of the hand is used to control the bleeding from the episiotomy. Occasionally folded gauze is placed in the wound which an assistant holds with one finger. If the child's head is in the transverse diameter, I place my first finger in the upper Lambdoid suture (the baby's right) and make pressure upward in a circular manner. My left hand placed on the fundus of the uterus presses downward at the same time. This simple maneuver will rotate the head in at least 75 per cent of the cases. If it does not succeed, the fingers are placed over the baby's left parietal bone and the thumb over the right, the head is pushed up slightly and rotated toward the mother's right. With external pressure it is guided downward into the pelvis again. This same method is employed in left occipitoposterior positions. In the latter, it occasionally is not possible to accomplish the rotation in this manner. In that case the head is pushed out of the pelvis, the operator's right hand grasping baby's left or posterior shoulder, carrying it toward the mother's left over the sacral promontory. As the hand is withdrawn, the baby's head is grasped and brought into the pelvis. In every case, one should endeavor to flex the head as it comes down into the pelvis. If the head has a tendency to rotate to its original position before the forceps can be applied, it can be held in its new position by grasping the scalp with an Allis forceps. The slight skin injury has never proved serious. After delivery, we usually touch it with iodine and put on a bandage.

The head should be rotated anteriorly at least to 45 degrees before the forceps are applied. The left blade is first placed over the parietal bone, then the right is inserted and applied over the opposite parietal bone. Before the blades are locked I listen to the fetal heart rate, using the head stethoscope. If, when the forceps blades are locked, the heart tones show any change in their rate, one may be sure that the cord is caught in the grasp of the blades. By manipulating the blades, we can usually push the cord aside. If this cannot be done, it means that we should deliver rapidly.

If the heart rate remains good, the delivery should be slow and deliberate, and should simulate nature as much as possible. If the head is not rotated directly anteriorly, by it is pushed upward by means of the forceps. It is then gently placed in the anterior diameter. A trial traction is made and the fetal heart tones again listened to. If normal, the delivery is effected slowly and easily. It is a great mistake to pull a head through the

vagina rapidly for two reasons. First, it is apt to produce a brain hæmorrhage, fracture the fetal skull, or rupture the tentorium. Second, the vaginal structures are subjected to great damage. Ordinarily nature doesn't hurry so; why should we?

Severe vaginal lacerations may also be caused by an attempt to rotate the head with forceps while traction downward is being made. The vaginal mucous membrane and the structure beneath are thus frequently torn from their attachment near the white line. This laceration is difficult to repair and it produces scars which are more or less painful for a long time after delivery.

When the baby's head is brought to the perineum the power of the traction should be lessened. If it is not, the episiotomy incision will be extended upward into the vagina and downward toward the ischiorectal fossa—two very unpleasant results. The head is, therefore, manipulated gently and brought to a point where the fenestra of the blades show for about 2 to 3 centimeters. The blades are then removed with great care lest an ear be damaged by being caught in the fenestrum. The rest of the head is delivered by stripping back the perineum with a large heavy towel folded twice. This protects the hands from fæcal contamination. When the chin is born, the folded edge of the towel is placed under it, to prevent it from touching the mother's rectum. One ampule of obstetrical pituitrin is given the mother as soon as the head is born. The child's mouth is cleansed and a minute or two allowed to elapse before the rest of the delivery is attempted. I prefer to deliver with a uterine contraction if possible, in which case the assistant grasps the fundus and does a Kristeller expression. One should never do a Kristeller on a relaxed uterus. If the uterus does not contract soon, the assistant places the palm of the hand on the baby's buttocks and presses it downward in the line of the axis of the pelvic inlet. At the same time, traction is made on the fetal head in a downward and backward direction. The operator and the assistant must work in unison. Too great a pressure must not be used, as there is danger of rupturing the uterus. This happened in one of my cases. If strong traction is exerted on the head, an Erb's paralysis is liable to occur. As soon as the anterior shoulder is brought under the pubis, the posterior shoulder is sought, the index finger placed in the baby's axilla and the shoulder extracted. If difficulty is experienced in extracting the body of the child because the anterior shoulder impinges above the pubis, the posterior shoulder is grasped and rotated anterior through an arc of 235 degrees. This will cause the anterior shoulder to rotate in a circular fashion downward into the hollow of the sacrum. This is called the corkscrew maneuver by De Lee. The rest of the body is then delivered. One cubic centimeter of pituitrin is given at this time. A sterile tray covered with a sterile towel is then placed on the operator's lap and the baby placed on the tray. A gauze sponge is placed about the cord at its exit from the vagina. This prevents the blood, etc., from running down the cord and contaminating the baby and the tray. After the baby is breathing well, the cord is tied.

Since we have been using the following technique in the care of the baby's cord, we have had very few cases of pemphigus. Those which have occurred were very mild.

The operator washes his gloves carefully in 1:2,000 bichloride solution and then in 1 per cent lysol solution. The cord is washed in 1 per cent lysol solution, dried with sterile gauze and painted with 50 per cent tincture of iodine. The cord tie, which has been soaked in iodine, is then placed in position. The cord is cut with a pair of sterile scissors. These scissors have not been used previously. The end of the cord is touched with a clean applicator soaked in iodine. The cord dressing is then applied.

By the time the operator has finished with the baby, the uterus is usually contracted down and the placenta is in the lower uterine segment. It is then expressed, inspected carefully and laid aside. The placenta is never expressed when the body of the uterus is relaxed for fear that the uterus may be inverted. The cervix is examined under direct vision and repaired immediately, if found torn. Interrupted sutures are placed, using No. 2, 40 day chromicized catgut. The episiotomy wound is then repaired.

If the patient begins to bleed badly after the delivery, the baby's cord is clamped in two places and cut between. The baby is handed to an assistant. The operator then gives his entire attention to the mother. If the bleeding is profuse, the left hand is inserted into the vagina under strict asepsis. A thorough examination is quickly made of the vagina, the lower uterine segment, and the body of the uterus to determine the cause of the hæmorrhage. Usually the placenta is found loosened and partly protruding from the body of the uterus. It is being expelled in the Duncan manner. We can assist nature by placing the left hand in the hollow of the sacrum with the palm up and tips of the fingers beneath the placenta. The right hand grasps the contracted

body of the uterus through the abdominal wall and presses it down in the axis of the pelvic inlet. The placenta slides out over the palm of the left hand. De Lee calls this the "shoe horn" method of delivering the placenta. One ampoule of ergot is given intramuscularly.

If the bleeding continues after the placenta is out and the uterus does not contract well, it is my custom to give ½ cubic centimeter of obstetrical pituitrin directly into the uterine wall through the abdominal wall. The nurse cleanses the skin over the abdomen with iodine and the needle is plunged through the abdominal wall into the uterine wall. My hand in the body of the uterus controls the depth of the needle point. The bladder and loops of intestine have been pushed out of the path of the needle by manipulating the body of the uterus. Within 30 seconds after the injection, the uterus begins to contract at the needle site. In a few seconds the contracting area is about 4 by 4 centimeters, then suddenly the entire body contracts very firmly. It remains contracted from the action of the pituitrin until the ergot previously given can get in its full effect. Since the giving of pituitrin in this manner, the necessity for packing the uterus for post-partum hæmorrhage has been reduced 75 per cent. If it is given under proper asepsis, there is little danger of peritonitis following, although one case is reported in the literature. Post-partum hæmorrhage is more frequent in operative deliveries for two reasons: first, the patient is more or less exhausted and does not respond well to ordinary stimulation, and second, the anæsthetic relaxes the uterus.

After hæmorrhage is controlled, I inspect the cervix and immediately repair any lacerations, using interrupted 40 day chromized catgut. Any lacerations of the vaginal canal are repaired with interrupted catgut while the episiotomy is repaired with two continuous catgut sutures and one subcuticular stitch of silkworm gut.

SIGMOIDOSTOMY AFTER RADICAL OPERATIONS FOR RECTAL CANCER

By ELLIOTT H. HUTCHINS, M.D., F.A.C.S., Baltimore

IN discussing carcinoma of the rectum, one of our greatest surgeons once said: "The best thing to do for such patients is a colostomy or sigmoidostomy and let them die in peace."

The purpose of this paper is to describe a method of colostomy or sigmoidostomy which will allow the patient to live in comfort, after he has been cured of his cancer.

For years my horror at the mutilation incident to the radical removal of cancer of the rectum was intensified by the fact that even a successful dissection left the patient in a pitifully helpless and uncomfortable condition which had to be endured for the remainder of his life, so that I had about decided that in such cases surgical interference was contra-indicated except for a palliative measure, when obstruction was complete.

Because of the difficulty of making an early diagnosis of cancer of the rectum and on account of the possibility of a concurrent infection and the protean aspects of cancer of the intestine in general, I have never been able to convince myself that restriction to the posterior route was justifiable in dealing with so serious a condition. Nay more, I believe that radical interference for removal of a rectal cancer should never be undertaken before an exploratory abdominal incision has been made through which a careful inspection of the rectum, of the sigmoid with the adjacent structures, including the lymphatics, and especially of the liver, has been rendered possible. Unless we are sure of the condition with which we have to deal many a patient will be subjected to a so-called radical treatment which in reality is not radical but is equivalent to an amputation of the breast for carcinoma while the axillary glands are left undisturbed.

Whether the operation be done in one stage or in two stages is not the important point. If the colostomy is unsatisfactory, the life of the patient, even after being cured of cancer, will still remain almost unbearable. Hence our aim should be not only to cure the patient of the cancer, but also to enable him to live afterward in comparative comfort.

A colostomy located in front is obviously preferable to one behind, if there is a lack of sphincteric control.

Until the past 2 years my experience with colostomies has been that they function either insufficiently or too abundantly. Instead of being formed, the evacuations are almost fluid so that they are collected and held with difficulty, a condition very disagreeable to the patient and also to his friends. W. W. Keen has pointed out that the usual location of colostomies is objectionable because they occupy the most freely movable part of the abdomen, whereas the best situation is near the umbilicus where there is less motion and where an apparatus may be most effectively worn.

About a year ago, in a case of cancer of the rectum, as a part of the operation I made a sigmoidostomy which I hoped would give the patient something approaching normal movements of the bowels. I attempted to bring about a stasis in the loop of colon adjacent to the opening sufficient to permit of the absorption of any superabundant fluid, so that the bowel contents would be formed and the patient could have a stool perhaps only once a day and remain comfortable and free from odor for the next 12 or 24 hours. It was my object to place this loop in such a position that it would not contaminate the peritoneum or be difficult to get at if trouble occurred. I also wanted it close to the surface so that any sluggishness or impaction might be easily counteracted by massage from without.

In preparing for the operation the following points were taken into consideration: (1) Unless strict precautions were taken, an extensive dissection such as I had in mind, together with division of the colon, might subject the patient to infection within the tract that I proposed to make. (2) The blood supply to the portion of the colon utilized in this operation might be disturbed during the operation or possibly after it, and gangrene of the loop might follow. For this reason, I watched the patient carefully during and after the operation in order to detect any disturbance of circulation or infection that might take place along the course of the new tract. I intended to incise directly over the point where the colon entered the abdominal wall, if occasion demanded, and revert to the old method of colostomy.

There is a temptation to conserve too much of the sigmoid and resect too close to the growth or too low in the pelvis to permit proper removal of the possibly involved glands. Of course the

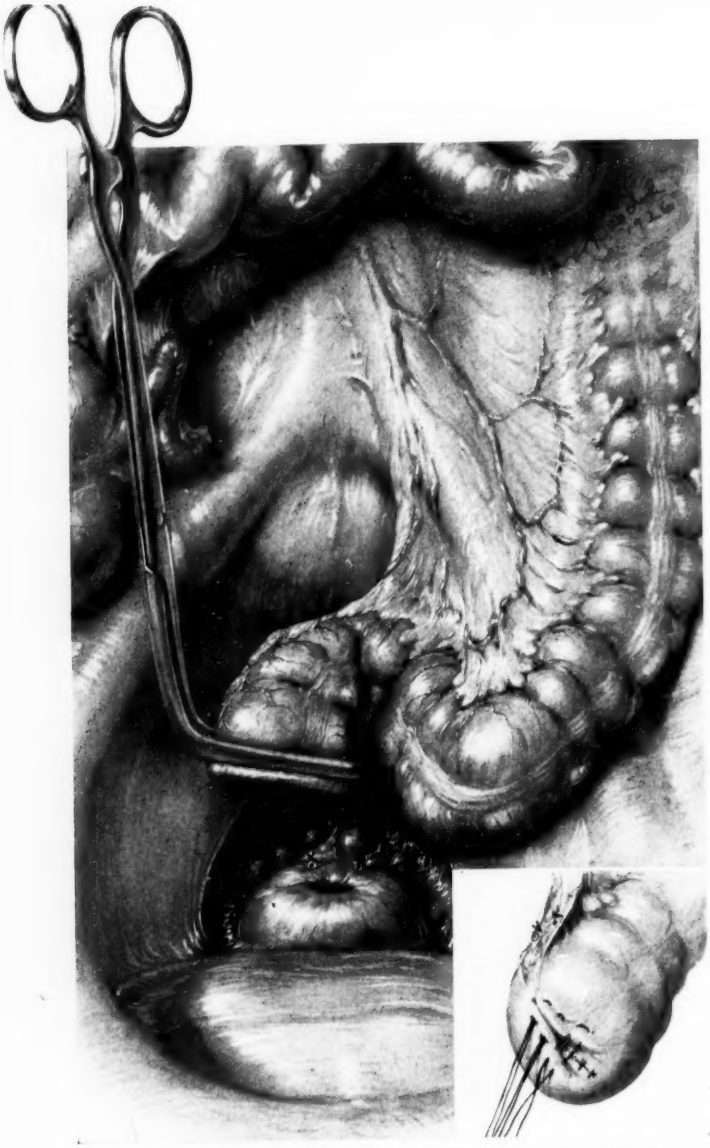


Fig. 1. Shows division of the sigmoid with ligation of superior hæmorrhoidal. The distal end has been closed and inverted. The insert shows the closure of the proximal end with the suture ends left long to be used as a tractor.

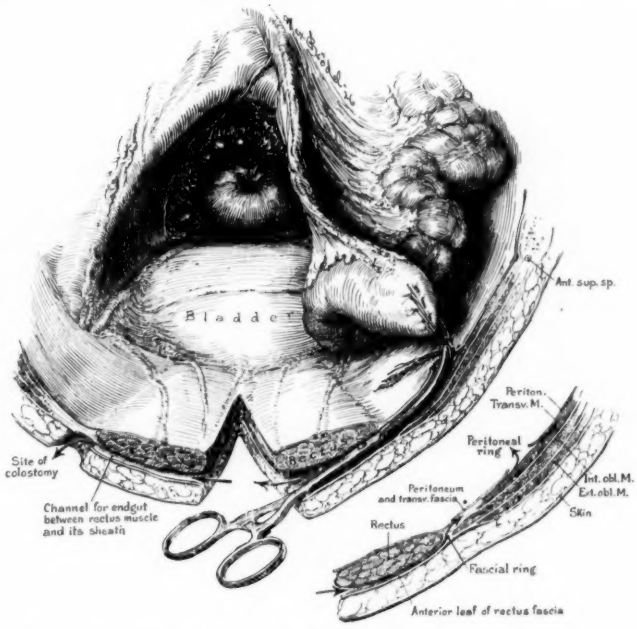


Fig. 2. An outline of the tract through which the sigmoid is to be drawn by attaching the long ends of the sutures in the stump to a long Kelly clamp. The insert gives a clearer picture of the anatomical structures through which the sigmoid passes.

surgeon's first duty is to handle the cancer properly, after which he should do the best he can in providing an artificial anus.

If the sigmoid has not enough viable tissue to reach across the abdomen, the colostomy must be modified accordingly.

The operation for resection of the rectum is so familiar that a description of the various steps preceding the division of the sigmoid will be omitted. The division is made between clamps by means of the cautery. The distal end (Fig. 1) is closed and inverted; the proximal end is closed, the suture ends being left long. The sheath of the rectus abdominis muscle on the left side is clamped within the margin of the incision, and the belly of the muscle (Fig. 2) for a distance of about 3 inches is separated from the anterior sheath across the entire muscle. The left margin of the sheath is then punctured and the opening enlarged to the caliber of the first opening or about 3 inches. The tract is then prolonged so that it passes backward to the fascia of the two oblique muscles and the transversalis and between the peritoneum and muscles to a point in the left lower quadrant corresponding to the natural curvature which the sigmoid makes as it is about to pass over the rim of the pelvis. This point is selected in order to utilize the curvature of the sigmoid to prevent an abrupt change in the direction of the intestine which might favor blockage of the circulation.

The sigmoid is mobilized from without inward in order to conserve its blood supply. Both branches of the superior hæmorrhoidal artery are ligated before the rectum is divided. The sigmoid is carefully examined to make sure that there is a proper blood supply. The long ends of the sutures utilized in closing the end of the sigmoid are fed into a long Kelly clamp which has been passed through the new canal in the abdominal wall. Gauze is wrapped around the end of the stump and by gentle traction, aided by pressure upon the loop, the sigmoid is drawn into the new canal. A dissection similar to that on the left is made on the right by separating the belly of the muscle from the anterior sheath, the tract being made to pass through the aponeurosis of the oblique muscles on the right side and emerge through

Fig. 3. The sigmoid occupying the artificial canal showing the need of a large internal ring to accommodate the blood supply. It also illustrates that by proper location of the internal ring the normal curvature of the sigmoid may be utilized to aid circulation. The extraperitoneal drainage tract passing above the symphysis down over the bladder into the denuded area is represented by gauze over which the peritoneum is being closed.

the skin near McBurney's point. If the length of the sigmoid permits, it ought to be drawn well through the opening (Fig. 3) and fastened by means of sutures in the aponeurosis of the external oblique as well as in the skin. Needless to say the sigmoid must not be subjected to undue tension. The midline incision is then closed.

The peritoneum and muscles (Fig. 4) are closed behind the sigmoid which crosses about midway of the incision. The fascia is closed in front of the sigmoid, care being taken not to compress the latter unduly. The subcutaneous fascia is closed in order that, if possible, the skin may remain freely movable, and the skin is closed with interrupted silkworm-gut sutures.

The sigmoid is not opened for 48 hours, this interval being permissible, thanks to the tolerance against obstruction naturally possessed by the colon. At the end of 48 hours the sigmoid is opened by removing the stitches from the end of stump, and the contents are allowed to escape (to the side of the patient). *All dressings over the colostomy and midline, except directly over the drainage tract, are removed and the incisions are subjected to the dry treatment under an electric bulb.*

Second operation. As soon as the condition of the patient warrants it, we proceed to the second stage. An incision is made beginning about the lower end of the sacrum and extending down to the bone, in the form of an ellipse. It is then prolonged forward so as to pass beyond and to include the anus and the sphincter muscles. The pelvis is entered by dividing the lower end of the sacrum and disarticulating the coccyx. By blunt dissection the entire rectum and surrounding tissues are quickly removed, as described by Coffey. The area about the urethra is then gone over with the electric cautery with the hope of destroying any cancer cells that may be present, but not extensively enough to damage the structures about the urethra and bladder. The huge space resulting from this dissection is swabbed with mercurochrome and then carefully packed. Dressings are then applied, sufficient pressure being applied to prevent oozing.

In my two cases convalescence was prolonged, but otherwise uneventful. Considerable time was

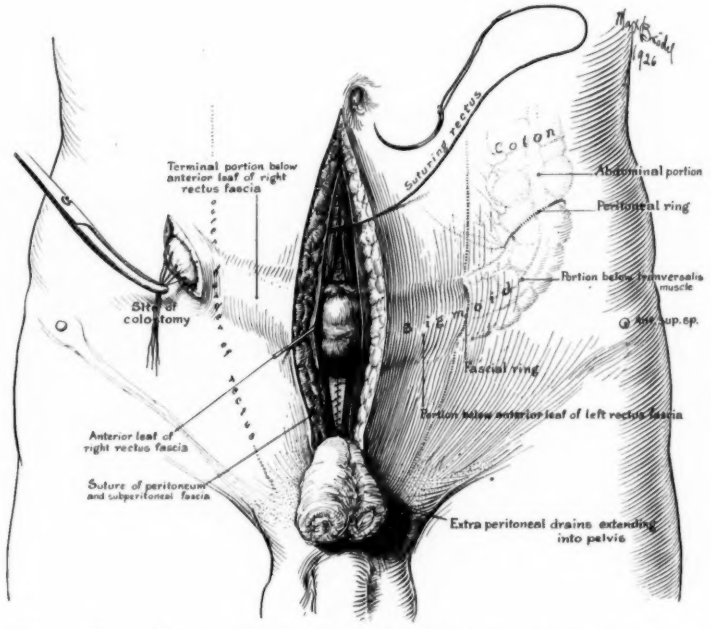

Terminal portion below anterior leaf of right rectus fascia
Suturing rectus
Colon
Abdominal portion
Peritoneal ring
Portion below transversalis muscle
Site of colostomy
Sigmoid
Fascial ring
Portion below anterior leaf of left rectus fascia
Anterior leaf of right rectus fascia
Suture of peritoneum and subperitoneal fascia
Extra peritoneal drains extending into pelvis

Fig. 4. The peritoneum and muscle are being closed posteriorly to the sigmoid which crosses the midline about halfway between the umbilicus and symphysis. The anterior sheaths of the recti are closed in front of the sigmoid. Extraperitoneal drains may be seen protruding through the lower end of the incision.

required to fill the huge space behind with granulations. Both of my patients are now working, one as a carpenter, the other as a plumber, and are perfectly comfortable. One told me that he had a normal stool every morning and could go without his apparatus if he wished to do so.

Of course, the value of an operative procedure cannot be based upon the results in two operations. But even such a small number suggests possibilities of diminishing the horror in the minds of victims of rectal cancer and giving them the hope of living in comfort instead of "dying in peace."

RADIOGRAPHIC SIMULATION OF RENAL CALCULI BY PAPILLOMATA OF THE SKIN

Report of Two Cases

By M. M. MELICOW, M.D., and HAROLD H. GILE, M.D., New York
From the Urological Department of the Presbyterian Hospital and the College of Physicians and Surgeons, Columbia University, New York

IT HAS been recognized for some time that papillomata, fibromata, warts, and moles of the skin may cast shadows on X-ray films, the misinterpretation of which may lead to errors in diagnosis. Pirie, in 1910, included pigmented moles in the class of extraneous substances which might cause shadows in X-ray films. Holmes and Ruggles state that warts and fibromata of the skin may give shadows which if they occur in the region of the kidney or gall bladder may be mistaken for calculi. Brief mention of this possibility is made by Cabot.

Within the past 2 months we have had two cases in which papillomata on the patient's back cast shadows in the kidney region resembling renal calculi. In both instances their correct interpretation was of considerable importance as to diagnosis and treatment. The summary of the two cases is as follows:

Case 1 (No. 58936). A 33-year-old Italian laborer complained of indefinite pain in the lower right quadrant of the abdomen. A barium enema was given on account of the finding of a questionable mass at the site of the pain. The X-ray showed no pathology of the colon, but superimposed upon the shadow of the left kidney, a fairly large, slightly irregular homogeneous dense shadow was noted, which had the characteristic appearance of a kidney stone. An X-ray of the kidney region, taken at a later date, confirmed that finding. Cystoscopic examination with pyelogram of left kidney was normal. During this procedure the papilloma of the skin in the left lumbar region was noted. The papilloma was excised, and plates taken subsequently showed that the shadow was no longer present. The excised tumor when X-rayed cast a dense shadow. Pathological diagnosis was papilloma. No evidence of calcification was seen. Chemical analysis showed a trace of calcium, phosphorus, and magnesium. This was no more than the amount found in any specimen of skin and was not considered sufficient to account for the dense shadow.

In this case, had this shadow been on the same side as the pain, it is not inconceivable that the patient might have suffered an unnecessary operation.

Case 2 (No. 65292). A 44-year-old Austrian male was admitted with a complaint of intermittent attacks of pain in the left flank associated with frequency of urination, occasional hæmaturia, and the passage of "gravel." He was tender over the left costovertebral angle and flank. His urine showed pus and red blood cells. The cystoscopic examination revealed a calculus 4 centimeters in diameter, in an acutely inflamed bladder. The left ureteral orifice was markedly inflamed and bulging. A continuous cloudy flow of urine was obtained from this side; while the urine from the opposite side was clear and intermittent. Function: left, 4 milligrams urea per 100 cubic centimeters; right, 25 milligrams urea per 100 cubic centimeters. Microscopic examination: left, pus, red blood cells, and casts; right, negative. The left pyelo-ureterogram showed a double pelvis with dilatation of all the calyces and the ureter. In the region of the right kidney the X-ray revealed a shadow which was thought to be a stone. On examining the patient's back a pedunculated skin tumor was noted in this area. A pyelogram was made, while the end of a probe was placed against the tumor. The X-ray showed the probe pointing directly to the suspected

Fig. 1

Fig. 1. Case 1. Roentgenogram which was taken before the excision of the papilloma, showing the shadow in the left kidney region.

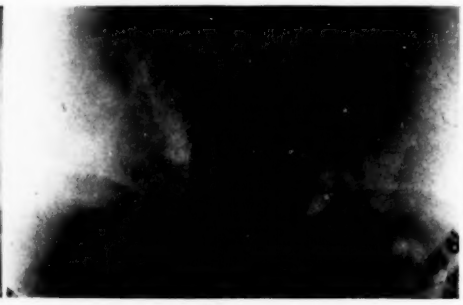


Fig. 2

Fig. 2. Case 1. Roentgenogram taken after excision of papilloma, shadow is no longer present.

Fig. 3

Fig. 3. Case 1. X-ray of excised papilloma.

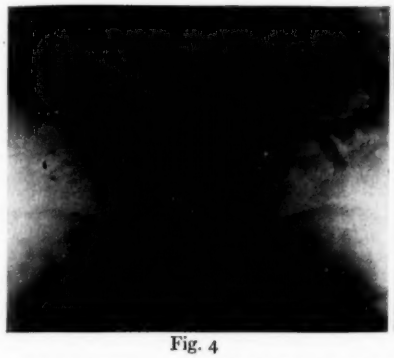


Fig. 4

Fig. 4. Case 2. The left pyelo-ureterogram. In the region of the right kidney is a shadow which was thought to be a stone.

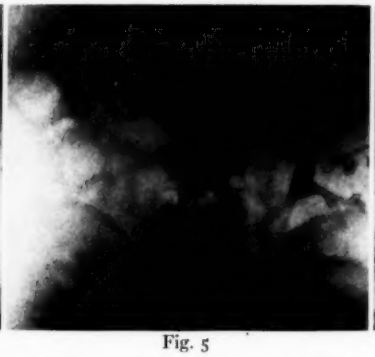


Fig. 5

Fig. 5. Case 2. Right pyelogram with probe pointing to shadow. Shadow disappeared on excision of the tumor.

Fig. 6

Fig. 6. Case 2. Photograph of papilloma of skin of back.

shadow. The papilloma was excised and an X-ray taken afterward showed no shadow. Pathological diagnosis: fibroma, no evidence of calcification. Chemical analysis: no calcium, phosphorus, or magnesium.

The finding of the shadow in this case raised the question of bilateral kidney involvement, and until the excision of the tumor proved that it was not caused by a renal stone, there was some hesitation about operating on the definitely diseased side.

In neither of these specimens was there found sufficient calcium, phosphorus, or magnesium to explain the X-ray pictures. The following two points seem to be of more importance in accounting for the density of the shadows than the mere heavy metal content of the tumors:

1. In the taking of the pictures the tumors were in a position nearest the film and their shadows were therefore relatively intensified in comparison to shadows cast by parts farther away.

2. Being attached to the back by a narrow pedicle these growths were almost completely surrounded by air, which gave them a sharp contrasting medium.

These points were brought out in experimental plates taken with the excised tumor placed at varying distances from the body. The deepest shadow was formed when the tumor was allowed to hang free from the arm, whereas only a very faint shadow was seen when the arm compressed the tumor tightly. In the latter instance, the air medium was practically eliminated.

CONCLUSIONS

1. Two cases are reported where papillomata of the skin of the back cast shadows in X-ray plates which resembled those of renal calculi.

2. The pathological report on the excised tumors was: for Case 1, papilloma of the skin; for Case 2, fibroma of the skin.

3. Chemical analysis of the excised tumors showed: in Case 1, a slight trace of calcium, phosphorus, and magnesium; in Case 2, no trace of calcium, phosphorus, or magnesium.

4. The significant factors governing the density of the shadows caused by these tumors seem to be their relative nearness to the film, and the amount of air which surrounds them.

5. The two cases illustrate the importance of looking for and noting the presence of any skin growths when referring a patient for radiography.

REFERENCES

HOLMES and RUGGLES. Roentgen Interpretation; a Manual for Students and Practitioners. Philadelphia: Lea & Febiger, 1919, p. 24.

PIRIE, A. H. Interpretation of X-ray negatives. Brit. M. J., 1910, part 2, p. 584.

CABOT. Urology. vol. i, p. 124. Philadelphia: Lea & Febiger, 1924.

MALIGNANT TUMORS OF FATTY TISSUES[1]

By J. V. SEIDS, M.D., and R. S. McGINNIS, M.D., Cleveland, Ohio
From the Surgical Service of Dr. C. A. Hamann and the Department of Pathology, St. Vincent's Charity Hospital.

THIS communication is concerned with those infrequent tumors composed of fatty tissue which are considered to be malignant because of their cellular composition, their recurrence after operation, their invasion of adjacent parts, and their tendency to metastasis. The common benign lipoma is not included.

A fatty tumor of this type was observed and recorded by Morgagni, who refers to apparently similar cases reported by other authors. No accurate histological study was published until 1857 when Virchow reported the case of a tumor which he designated myxoma lipomatodes. This tumor originated in the thigh and metastasized to the brain and spinal column. He compared the mucous tissue with its intracellular and extracellular fat droplets with embryonic connective tissue which was about to differentiate into adipose tissue. Foerster in the same year reported a mucoid sarcoma with fatty changes. All degrees of fat deposit in the fibroblasts, from minute globules to adult fat cells, were observed. He obviously believed the fat to be of secondary importance. In 1858 Senftleben removed from a boy's face a tumor which he designated a myxoma lipomatodes. Embryonic fibroblasts containing varying amounts of fat were seen in the sections.

A remarkable fatty tumor weighing 275 pounds was reported by John Delamater in 1859. This tumor developed retroperitoneally and a portion extended through the pelvis to form a perineal tumor 4 feet in diameter. The circumference of the abdomen was 7 feet 8 inches.

A huge lipomyxoma originating in the mesentery and giving rise to secondary sarcomatous deposits in the liver and lungs was reported by Waldeyer in 1865. In the same year, Virchow reported a case which he designated as a lipoma myxomatodes malignum with similar deposits in the lungs. Two years later Burow reported a highly vascular lipomyxomatous tumor of the thigh which he designated lipoma myxomatodes telangiectaticum.

Holmes gives Péan credit for the first attempt at surgical removal of a retroperitoneal lipoma, in 1880. In 1884 Grawitz differentiated hypernephromata from the heterogeneous collection of cases previously regarded as lipomata. In 1896 Adami collected 42 cases of liposarcoma and added two of his own. Robertson in 1916 reviewed 51 cases and added a careful analysis of his own case. In 1921 von Wahlendorf published a critical review of 168 collected cases and summarized the literature to that date.

As may be noted in the preceding paragraphs, a confusing nomenclature exists in the literature. In order to avoid the complexity of vague descriptive terms, we prefer to designate these tumors liposarcomata, a term which expresses their general nature, rather than enumerate the various tissues encountered histologically.

GENERAL CHARACTERISTICS

These tumors occur most frequently between the ages of 40 and 60. The incidence in the cases compiled by Robertson and von Wahlendorf is as follows:

	Robertson	Von Wahlendorf
Up to 20 years	2	10
21 to 40 years	17	40
41 to 60 years	20	72
Above 60 years	8	7

Bork reports a case which he regards as congenital, and which was operated on at the age of one year. Occasional instances have been encountered in older children.

The sex was given in 148 of von Wahlendorf's cases: 106, 72 per cent, occurred in females; 42, 28 per cent, occurred in males. In Robertson's series, the sexes were more evenly divided: 25 of 49 cases, in which the sex was noted, were found in males and 24 in females. The greater frequency in the female in von Wahlendorf's cases is explained by their greater tendency to the accumulation of fatty tissue.

Von Wahlendorf's series included only tumors of retroperitoneal origin. One hundred and four, 79 per cent, were within the pelvis; 30, 23 per cent, were classified as arising from the renal capsule; 46, 35 per cent, from the perirenal and lumbar fat, and 26, 20 per cent, from the mesentery. Some writers doubt the mesenteric origin on account of the ease with which retroperitoneal tumors may grow forward between the layers of the mesentery. However, a few authentic cases have been described. Robertson's cases include tumors from various regions, distributed as follows: 22, 43 per cent, associated with the leg muscles; 12, 23 per cent, retroperitoneal; 3 in the mesentery; 3 asso-

[1] Received for publication April 29, 1926.

ciated with the arm muscles; 3 were located in the face; 1 was in the pleural cavity, and 1 in the kidney.

Much discussion has arisen as to the origin of fatty tumors in the regions of the kidney where no fat is normally found. That these tumors may develop within the renal parenchyma and attain a sufficient size to be of surgical importance is illustrated by Warthin's case of a fibrolipoma growing between the cortex and medulla. It measured 14 by 8 by 6 inches and weighed 2 pounds. Hartwig's case of a liposarcoma, which was attached to the kidney and weighed 3,500 grams and showed metastatic nodules in the adjacent kidney substance, was considered to have arisen from a cortical lipoma. Alsberg reported a case of multiple lipomata of the kidney which varied in size from a millet seed to a walnut.

According to Grawitz these tumors owe their origin to developmental inclusions of the fatty capsule or aberrant adrenal rests which have undergone fatty degeneration. Virchow considered them as arising from kidney cells which have undergone a primary overgrowth with subsequent replacement by fat. These he terms heteroplastic, and true lipomata of this type rarely exceed the size of a cherry stone. Another variety he considered due to hyperplasia of pre-existing fat. This type commonly arises following inflammatory lesions, usually of the pelvis. In 9 out of 10 cases recorded by Selter, renal calculi were found associated. This is probably atrophy with a fat replacement as may often be seen in wasting organs.

As shown by von Wahlendorf's studies, there is a wide distribution within the abdominal cavity. He cites the following unusual locations: Peyrot's case of a lipomyxosarcoma in the gastro-hepatic omentum, Alsberg's report of a lipoma of the transverse mesocolon, Chiari's case of symmetrical lipomata around both ureters resulting in death from renal insufficiency, and Neuport's citation of a case of liposarcoma of the perirectal fat which descended through the inguinal canal onto the thigh, forming a tumor the size of an adult head. Cases are described as developing from the neural sheaths, but we have encountered no cases that could be so classified. One of our cases which later invaded the sciatic nerve, arose from the surrounding fat. That subcutaneous lipomata may become malignant is illustrated by cases described by Jacobson and Robertson. That they may assume large proportions, is shown by Little's case of a lipomyxoma arising from the face and the side of the neck. It weighed 30 pounds.

These tumors are probably the largest of solid growths encountered. McConnell's case, weighing 65 pounds, represents the largest of these growths removed at operation. Hirsch and Wells report a liposarcoma removed at autopsy which weighed 69 pounds, and Waldeyer records one of the mesentery which weighed 63 pounds, and there are numerous reported cases of 30 to 40 pounds weight. These tumors, when located elsewhere, do not reach such huge dimensions. The enormous size of Delamater's tumor has been commented upon. The rate of growth is usually slow, but with malignant change may become quite rapid.

ETIOLOGY

As in most other tumors, little is known of the etiology. The following theories have been advanced by different authors: (1) Retroperitoneal lipomata may be considered as a lipomatosis of this region due to a constitutional predisposition to lay down fat as is seen in Madelung's fatty neck and symmetrical lipomatosis elsewhere. (2) Embryonic origin from misplaced mesenchymal cells or a congenital anlage which begins development at any age. (3) Nutritional disturbance including alcoholic abuses has some advocates. (4) Askanazy's demonstration of fat due to degeneration in the lymph-nodes has also been applied here. Ewing regards this rather as a replacement lipomatosis, similar to that seen in other atrophic organs. (5) Korman and Chiari considered inflammation as a causative factor and compared it to inflammatory processes in the liver, spleen, and kidneys. (6) Fatty degeneration of misplaced adrenal rests is also advanced. This may account for some of the lipomata found within the kidney capsule but it can hardly be called upon to explain the origin of the huge retroperitoneal lipomata. McConnell endeavors to trace the origin of his tumor to this source, but the connection appears vague. Keenan and Archibald's case illustrates this view. (7) Trauma and exertion have also been mentioned. Trauma, however, is claimed for so many tumors but may be considered usually as merely drawing the patient's attention to the region in question, or after having the presence of a tumor called to his notice, he can usually bring into play a fertile memory. Masson and Horgan mention two cases which developed lipomata in the renal region after exploration for renal calculi.

SYMPTOMS

Well defined or characteristic symptoms in abdominal tumors are usually wanting. The growth

is apt to be so slow and insidious that the tumor often reaches a formidable size before the patient seeks medical advice. It is not uncommon for tumors of this nature to be detected during the course of a careful physical examination for some irrelevant complaint. General symptoms complained of are: loss of weight, which may be quite marked, or a condition of wasting which may be manifested while the body weight is kept up by the increasing size of the tumor. Weakness and loss of endurance are sometimes mentioned. Changes within the tumor may incite rather marked constitutional symptoms such as fever, malaise, sweating, loss of appetite, nausea and vomiting, and leucocytosis when infection or necrosis of the tumor takes place. Sudden collapse may be induced, as in the case reported by Hartwig, if hæmorrhage takes place within the tumor. In the larger tumors, dyspnœa which may be distressing is observed. Œdema of one or both legs may result from pressure on the large abdominal veins or varicocele from obstruction of the spermatic veins. Few, if any, constitutional symptoms occur as a result of tumors outside the abdominal cavity. The local symptoms are correspondingly vague. It seems hardly possible for tumors to reach such enormous proportions and be accompanied by so little disturbance. Tumors within the abdomen may cause a variety of gastrointestinal symptoms, such as nausea, vomiting, and a bloating sensation with a feeling of fulness and distress after taking food.

Constipation is often complained of, and occasionally diarrhœa occurs. Blood at times appears in the stool. It is conceivable that tumors originating in the perirectal fat might cause a considerable degree of obstruction. However, such marked intestinal manifestations are very uncommon. The urinary symptoms consist chiefly of frequency from pressure on the bladder, although compression of the ureters may result in hydronephrosis as in Chiari's case. Pain is a variable symptom. It may be quite marked in infected tumors or it may consist merely of a feeling of discomfort or a dragging sensation, especially exaggerated on stooping or bending. Backache is experienced at times. Pain along the course of nerves which are pressed upon is not infrequent. The most common picture is a slow, progressive, painless enlargement of the abdomen.

Tumors situated elsewhere announce their presence chiefly by the increase in size of the part, which may become so large as to cause great inconvenience with scarcely any pain. In other cases, local or referred pain when nerves are closely associated may be complained of bitterly.

DIAGNOSIS

The utmost difficulty is experienced by clinicians in the diagnosis of retroperitoneal tumors. Confusion with every conceivable tumor within the abdomen is mentioned, and even with the abdomen open, doubt as to the real nature has arisen in the mind of the operator, as is attested by the frequency with which the trocar has been plunged into the mass to withdraw suspected fluid. Tumors of the limbs and superficial structures offer less difficulty. It appears to us that the failure to bear in mind the possibility of this type of tumor when a given case is being considered is the biggest factor in the commitment of an error. The frequency with which the exploratory trocar has been used when confused with a cystic tumor or ascites, serves to emphasize the necessity of a correct diagnosis when one recalls the hazard attending this procedure.

These tumors may be mistaken for ovarian tumors, cysts, ascites, tuberculous peritonitis, uterine tumors, pregnancy, renal tumors—such as a polycystic kidney or hydronephrosis—perirenal abscess, adrenal tumors, splenic tumors, mesenteric cysts, retroperitoneal sarcomata and cysts, carcinomatosis of the peritoneum, and tumors of the pancreas, omentum, and liver.

Retroperitoneal lipomata are usually rounded, smooth, semifluctuant or doughy, sometimes lobulated and irregular masses, more prominent on the side of origin, and relatively fixed posteriorly. The consistency of a uniform tumor may vary from soft to firm in different locations, or, if lobulated, the different lobules may present the same variations. Undoubted cystic areas may be evident. The gut may be located by percussion and some idea gained by this maneuver as to the point of origin of the growth. Usually the large intestine may be demonstrated coursing over the top of the tumor by palpation or percussion, the direction depending upon the position of the tumor. To localize the large intestine, use may be made of the barium enema and X-ray. Bimanual palpation may reveal the tumor in the flank. The large intestine may be displaced either medially or laterally. The sense of fluctuation is distinct to be sure, but is never so marked as that encountered in ovarian tumors and ascites. The fluid wave is sluggish compared with that obtained in the tense walled cyst or well-marked acites.

The central zone of tympany in ascites and the semicircular zone in ovarian cysts should be helpful. Ascites dependent upon the pressure of these tumors on the portal vein, may be an accompanying feature and add to the confusion. Pelvic ex-

amination is disappointing as a mass may be encountered in either case, but the pelvic attachments of an ovarian tumor may be made out by combined examination. The cystoscope and pyelogram constitute the only means of differentiating renal tumors. In fact, renal function should be determined routinely when a tumor of this nature is suspected, in view of the fact that nephrectomy has been necessary in fully one-half of the reported cases. Much difficulty may arise in the case of large perirenal abscess owing to the fact that these tumors occasionally become infected and may closely simulate an inflammatory condition. The spleen should be differentiated by its sharp border, notch, and firm consistency encountered in splenomegalies, as compared with lipomata. The white count should not be omitted. The cystic nature of the mass is definite in cysts of the spleen, in which the border and notch are obliterated. Retroperitoneal sarcomata are much firmer in consistency, irregular in outline and more fixed than lipomata, and the emaciation is usually more striking. Adrenal tumors cannot be differentiated with certainty unless they assume the character of a sarcoma. Mesenteric cysts are usually smaller and more movable and their cystic nature may be made out. Pancreatic tumors do not attain the size of lipomata and are more irregular, nodular and firm. True pancreatic cysts are usually small and not apt to give rise to confusion. Pseudo-pancreatic cysts attain a larger size and are usually fixed. The cystic nature is quite evident. It is quite unusual for lipomata to occupy the midposition so often assumed by these cysts. Trauma frequently precedes this collection of fluid. Ruptured ectopic pregnancy is simulated when hæmorrhage within the tumor occurs as in Hartwig's case.

Subcutaneous liposarcomata should offer little difficulty. Deeply placed intermuscular lipomata are sometimes difficult to make out. Differentiation from bony tumors is afforded by the X-ray. Indeed, the X-ray may be, as in one of our cases, of material aid in outlining a deeply placed tumor in the soft parts, because of the difference in density between the tumor and the surrounding muscles. Disparity in the size of the limbs without much disturbance of function should be viewed with suspicion. Careful palpation will generally detect a fairly firm tumor which is more or less movable, unless malignant change has taken place, when it becomes fixed. Differentiation from sarcomata presents the greatest difficulty. These are firmer in consistency, more vascular, fixed, and accompanied by more pain and disturbance of function with involvement of regional lymph-nodes or distant metastases in the more advanced cases.

PATHOGENESIS

As before pointed out, these tumors may develop at different sites. The perirenal region and fascial planes of the lower extremities are the most frequent locations. Less frequent, but pursuing the same general course are those found in the mesentery, gastrocolic omentum, retrocolic, retrorectal, and paravertebral tissues. There are authentic cases reported which developed in the broad ligament, face, and muscle planes of the arms.

The occurrence of similar growths some distance from the main tumor has been frequently observed. This is consistent with Konig's hypothesis that there exists a primary diffuse anlage which extends from the space of Retzius, through Douglas' space and along the ureter to the kidney. A widespread developmental disturbance is suggested by the wide growth, variation in structure, and the intimate relations to the intramesenteric structures. A close genetic relationship is indicated by the fact that these tumors developing in the places cited, grow more rapidly and show more sarcomatous tendencies than the ordinary subcutaneous lipoma.

To account for the more rapid growth of the abdominal tumors, it has been pointed out that the great roominess offers little resistance to expansion. However, in the advanced growths this condition might be reversed, but no slowing of growth is observed.

Lipomatous, myxomatous, and fibrous elements are the common structures found in the tumors. Early, the lipomatous element predominates, but later the fat element may be in a great measure obscured by myxomatous and fibrous elements. Here, as in other neoplasms, degenerative changes with secondary infection, cyst formation, calcification, and even ossification may greatly alter the gross appearance.

Myxomatous tissue is so frequently present that its origin should be determined if possible. There may be a development from embryonal rests of mucous tissues and a pure myxoma formed; it may be the product of metaplasia of other tissues, such as the fibrous or fatty structures producing the secondary myxomata; a third possibility is the spurious myxoma resulting from chronic œdema of other elements. The primary type is undoubtedly very rare, but we believe either of the other types may develop with the metaplastic type most frequent.

The surgeon may have little interest in the origin of the mucoid structures, but their presence in a lipomatous growth in the body regions cited, should arouse his suspicions of the possible malignancy of the tumor. And with this in mind, complete extirpation is done, bearing in mind that an unremoved portion may take on more rapid growth than the original structure. As before indicated, these tumors do not take their origin where fat is commonly deposited, such as fatty panniculus, appendices epiploicæ, and omentum.

PATHOLOGICAL ANATOMY

Macroscopic. These tumors usually shell out with little difficulty and appear to be for the most part well encapsulated. No uniformity of shape is observed. The growth presents varying degrees of consistency as should be expected from the predominance of any particular type of connective tissue. However, they are often slightly boggy and the shape is dependent upon the pressure of surrounding structures. When composed largely of fat, it is lobulated and the varying sized lobules are held by thin strands of connective tissue.

When sectioned, fatty structures occurring either in lobules or diffusely, may be seen. Translucent gelatinous zones from which a thick viscid mucinous secretion may run or can be scraped off are found in the mucoid areas. Soft, friable, whitish, and encephaloid appearing structures are found in sarcomatous areas. Cysts are not infrequent. They most often are due to liquefaction of myxomatous areas, although degenerative changes may account for many, and in an occasional case, a cavernous angioma may be surmised.

Microscopic. A word for the necessity of careful sectioning of the tissues may not be amiss as illustrated by Hertzler's experience. Tissue from which sections were prepared to illustrate typical myxomatous elements to a class was found, with repeated sectioning, to be sarcomatous. The information derived from the study of sections may be limited to the small piece excised, and this is especially true of this type of growth. Hence the diagnosis of malignancy may depend more on the care and thoroughness of the pathologist, than on any other factor. The different histological structures may be easily understood when we consider the frequent tendencies of any one of the connective tissue group of tumors to pass into or show areas of conversion into another type.

The fat may be dense, or show widely scattered cells which are as large or larger than the normal adult fat cell. These zones stain characteristically with Sudan III or any other routine fat stain. Extensive areas of a loosely woven network of communicating cell processes, having medium sized nuclei which are round or slightly irregular, are observed. The nuclei are fairly rich in chromatin and stain deeply with the basic dyes. These areas contain more or less homogenous, faintly basophilic material which gives the usual chemical reactions for mucus. Connective tissue may be dense and of a fibrillar type, or again it may be composed of fine branches. The sarcomatous areas are recognized by the usual criteria. The cells present no uniformity of shape, size, arrangement, or polarity. Polymorphism was quite striking in two of our cases. The cells were slender, fusiform, and spindle shaped, while at another point variably sized round cells with large dark staining nuclei and increased tendency to mitosis, were observed. No giant cells were found and in general the tendency to increased mitosis was not prominent. Penetration of the capsule by the above type of cells is indicative of malignant properties. A few thin-walled blood vessels may be found, but vascularity is less prominent than in sarcomata of other types.

It is a frequent clinical observation that these tumors continue to increase in size by laying on additional quantities of fat, while the host becomes more and more emaciated. However, there are no reported instances of decreasing size of ordinary lipomata when a patient was losing weight. Hirsch and Wells reported a tumor of this type, in the retroperitoneal region, which weighed 60 pounds, but at autopsy there were only scant deposits of subcutaneous fat. Their chemical studies revealed no difference in the fat or fat splitting enzymes of liposarcoma from ordinary fatty areolar tissues, and as they say, well illustrates the parasitic capacity of tumor tissue to hold fat needed by an emaciated host.

CASE 1. B 7369. A white, male, machinist, aged 39, was admitted to Charity Hospital, January 7, 1920, complaining of a lump in the right side of the abdomen. Four years previously, a fatty tumor had been removed from the region of the right kidney. He remained well until 7 months before admission when he noticed a lump the size of an egg in the right side of the abdomen. This had increased gradually in size. He had had pain in the region of the tumor for the past 2 months on stooping over and when urinating. There had also been some pain in the bladder and penis during urination. There had been a moderate frequency. His general health had been good in spite of a loss of 10 pounds in weight.

Physical examination revealed nothing of importance outside of the abdomen. Here a rounded, slightly lobulated tumor about 25 centimeters in diameter, and more prominent on the right side was in evidence. It extended into the right flank and well over toward the left and from about 5 centimeters above the umbilicus down into the

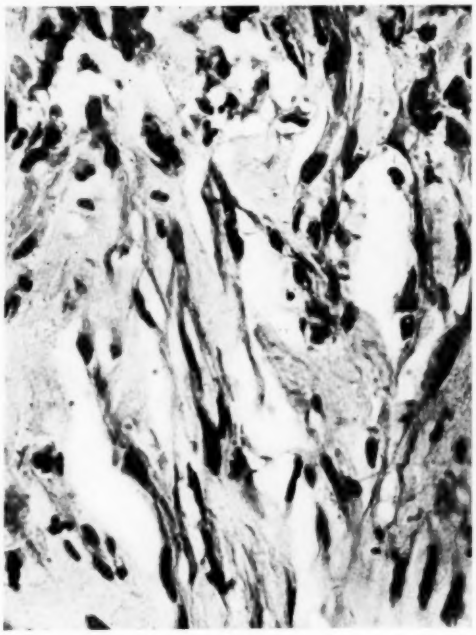


Fig. 1. Case 2. Section shows cells of the spindle type. Scattered outlines of fat cells can be seen.

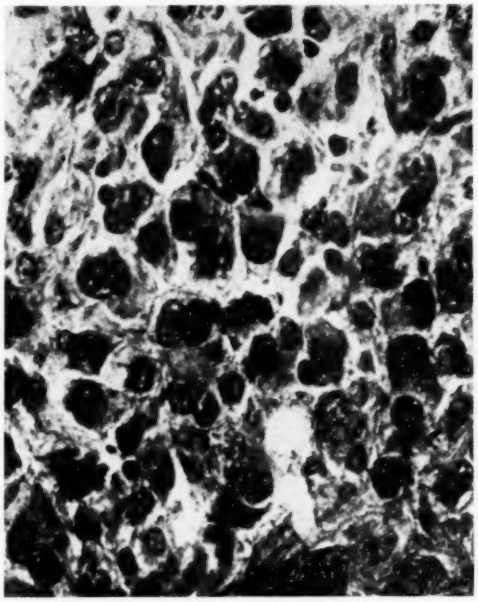


Fig. 2. Case 3. Showing the tendency to round type of cell with marked variation in size. Nuclei are stained deeply and mitotic diversion is quite marked. Oil immersion. × 350.

right iliac fossa. It was not tender. It was somewhat movable from side to side but not up and down. It was of medium consistency and this was uniform throughout.

Operation. The abdomen was opened through the former incision and the peritoneum on the outer side of the ascending colon was incised. The tumor was easily shelled out of a capsule which extended over into the left iliac fossa. In the right iliac fossa and flank, it was adherent and small portions remained. The right ureter was laid bare for a distance of 10 centimeters and the vena cava for a distance of 5 centimeters. There was very little hæmorrhage. The cavity was drained through the flank. The peritoneal wound was sutured.

Pathological Report. Gross description: The specimen showed a fairly well encapsulated tumor mass, measuring 22 by 25 by 17 centimeters. The growth was lobulated, and the consistency was variable in different parts. When sectioned, the specimen appeared to be composed mainly of fat, which in some areas was lobulated, but elsewhere scattered diffusely in a loose connective tissue structure. Soft, pale grayish zones from which mucoid material could be expressed were rather numerous. Extravasated blood had produced a few soft reddish areas. There was no marked fibrosis at any part and no calcification or cyst formation.

Microscopic description: The sections taken at different levels showed considerable variation in structure. There were areas of adult fat cells, which appeared as large vacuoles, the fat having been removed by solvents in the course of preparation. Areas of hæmorrhage and irregular stellate structures which stain a light blue were noted. Other zones were more cellular. Here and there were spindle and round cells, all apparently of an early undifferentiated connective tissue type. Roughly, there was an alveolar arrangement. Many thin-walled blood channels were present. Cellular zones showed moderate anaplasia, as illustrated by increased mitosis and a greater amount of chromatin material in the nuclei. Diagnosis: lipomyxosarcoma.

Second admission, July 4, 1920. The patient complained of a tumor in the right side of the abdomen which had gradually become larger during the past 3 months. Examination revealed an indefinite tumor mass filling the right side of the abdomen.

The treatment consisted of six injections of Coley's toxin, and intensive X-ray exposure, with apparent improvement.

Third admission, March 9, 1921. The patient was complaining of a return of the mass in the right abdomen and considerable pain in this region and in the back. There was also a frequent desire to urinate and some urgency. Physical examination revealed signs of an accumulation of fluid in the right chest. X-ray confirmed this. A firm, fixed, irregular mass which could not be distinguished from the liver was palpated in the right upper abdomen. At operation, several lipomatous masses, the largest the size of an egg, were removed from beneath the liver and in the region of the kidney.

Pathological report: Same as previous report.

The patient was discharged May 28, 1921, after a rather stormy convalescence during which several hundred cubic centimeters of sanguinopurulent fluid were aspirated from the right chest. Death occurred about 2 months later. It is quite certain that he had metastasis to the lungs and pleura, although no autopsy was obtained.

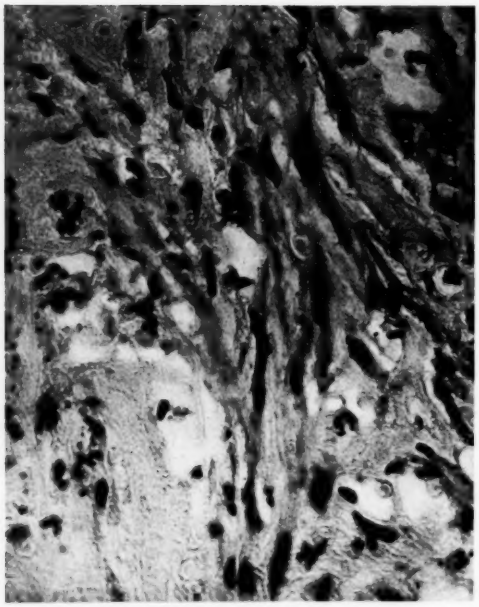


Fig. 3. Case 3. Showing a predominance of spindle cells. Mitosis is less prominent than in section shown in Figure 2. Cells closely resemble those shown in Figure 1. Oil immersion. × 350.

Fig. 4. Case 3. Section taken from the same tumor as that in Figures 2 and 3 but showing numerous vacuolated areas which are the outlines of fat cells. Oil immersion. × 450.

CASE 2. D 4702. A white female, age 47, was admitted to Charity Hospital June 4, 1922, complaining of a growth in the side, which she first noticed 8 months previously when it was about the size of a hen's egg. It grew gradually. She had noticed a moderate pain in this region after exertion, which fact led to the discovery of the tumor. There had been no gastro-intestinal or genito-urinary disturbances. She had had a dry hacking cough for the past few days and an evening rise in temperature.

Four years previously, the right kidney and a large perirenal lipoma had been removed.

Physical examination. Temperature was 103 degrees; pulse, 120; respiration, 18. A careful physical examination failed to reveal anything abnormal outside the abdomen, where a rounded, firm, freely movable tumor the size of an adult head was located. It occupied the right ileocostal region and though attached posteriorly, it could be moved about freely. It was not tender. No pelvic attachments could be made out. Urinalysis, negative.

The patient was kept under observation for a few days in an endeavor to explain the fever. No explanation of this was forthcoming, so she was operated upon, thinking perhaps that the tumor might be the cause. A tumor about 20 centimeters in diameter was found retroperitoneally occupying the right hypochondrium and iliac regions. The peritoneum was incised to the outer side of the colon and the tumor enucleated readily. A smaller tumor the size of a kidney was removed from the renal region. The retroperitoneal space was drained with a rubber tube. The temperature returned to normal the third day after operation. The remainder of her convalescence was uneventful.

Pathological report. Gross description: Specimen showed two tumor masses. The larger measured 20 by 25 centimeters, was oval-shaped, apparently well encapsulated and weighed 1526 grams. The periphery was somewhat irregular because of three subcapsular masses the size of an egg. When it was sectioned, the growth presented a yellowish white structure of rubbery consistency. Smaller zones, soft in nature, and of golden yellow appearance, represented fat deposits. Numerous small, fairly firm, greyish areas of fibrous tissue were present. The smaller tumor was the size of the normal kidney and closely resembled the larger growth.

Microscopical description: Several sections were studied. Throughout, the cells were distinctly polymorphous. Some of the sections showed mucoid, lymphoid, and embryonic connective-tissue cells of a distinctly embryonic type, loosely interwoven and supported by a poorly formed connective-tissue reticulum. Thin-walled blood channels were numerous. Walls of many vessels were formed by the tumor cells. Nuclei of most of the cells took a deep stain, but a tendency to mitosis was not prominent. Near the periphery, the structure was more dense and distinctly sarcomatous in appearance. Only an occasional vacuolated cell was to be seen. Diagnosis: lipomyxosarcoma.

Second admission, November 18, 1923. She had gained some in weight and had been quite well except for the fact that she had discovered a lump in right lower abdomen. The examination showed a fixed mass the size of an orange in the right lower quadrant. At operation, one tumor the size of the fist and a number of smaller growths were removed from the retroperitoneal space.

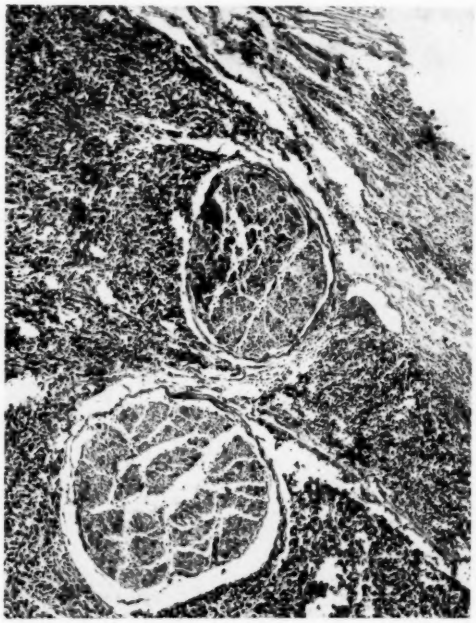


Fig. 5. Case 3. Section of tumor involving the sciatic nerve. The nerve fiber is completely surrounded by sarcomatous elements. The perineurium has been destroyed and at one edge can be seen an extensive area of necrosis. × 45.

Fig. 6. Case 4. Section of fibrosarcomatous area of a tumor which at some points still retains the gross and microscopic appearance of a lipoma. In this case the tumor masses varied in size from a large grapefruit to a plum. × 85.

The pathological report was the same as that of the former operation. She had had a number of X-ray treatments, and when last seen, one year after the operation, her condition was excellent and there was no recurrence.

CASE 3. C 10,979. A white female, aged 60, was admitted to Charity Hospital, December 13, 1922, complaining of pain and swelling, in the left leg, which had been present for 2 years. In the beginning, this condition was thought to be due to varicose veins. She was somewhat relieved by wearing elastic stockings. The thigh continued to increase in size and became quite painful. An X-ray shortly before admission, revealed a tumor in the soft parts.

Physical examination. Upon the posterior aspect of the left thigh midway between the knee and hip, there was a deeply placed, firm, rounded tumor about 15 centimeters in diameter. Movement was intensely painful. Growth was not fixed to the bone.

Operation. A long curved incision was made and the growth was easily shelled out from between the posterior group of muscles. The growth extended partially around, but did not involve, the sciatic nerve. The main tumor was about the size of a child's head. It was distinctly firm and fibrous in character but part of it looked like a typical lipoma. There were a number of smaller fatty nodules which extended between the muscles and into the popliteal place.

Pathological Report. Gross description: Specimen showed one tumor measuring 20 by 22 centimeters, which was distinctly lobulated. When sectioned, it presented partly fatty, partly fibrous, and definite myxomatous zones. The fat tissue predominated. A smaller number of growths the size of a tangerine were present. They were definitely fatty and showed no mucoid or fibrous areas.

Microscopical description: Sections were taken through various portions of the tumor growth, and all showed practically identical pictures with, however, some disproportion in the component elements. Fibrous connective tissue of a rather loosely arranged, somewhat immature type, myxomatous tissue, fairly numerous multinucleated rather deeply chromatic cells and characteristic reticular fibrous connective tissue enclosing vacuolated spaces were present in all the sections and were relatively, on the whole, equal in proportion. Diagnosis: fibromyxolipoma.

Note. This tumor is one which is almost certain to recur, and the recurrent growth will probably be much more cellular.

Second admission, January 19, 1924. The patient was complaining bitterly of pain in the left leg. She had felt well until 7 weeks prior to this admission when she fell and sustained a fracture in the region of the left ankle. Since the removal of the cast which was applied, she had been suffering from intermittent attacks of severe stabbing pains in the lower leg, which had gradually extended upward toward the thigh. The worst pain was located in the outer aspect of the lower third of the thigh. She complained of numbness of the leg and foot.

Special examination: There was a hard, fixed, deeply placed tumor in the middle of the posterior aspect of the left thigh below the old scar. The outline was indefinite

and the surface somewhat irregular. It was about the size of a grapefruit and was quite tender.

Operation. There was a recurrence of the tumor previously removed in the midthigh posteriorly. She had some evidence of irritation of the sciatic nerve. The growth was found beneath the ham-string muscles, under and around the great sciatic nerve. It was 2 to 3 inches long, somewhat broken down and poorly encapsulated. As much as possible was removed and the cavity drained.

Pathological report. Gross description: Four small pieces of tissue were received, showing small indurated nodules which varied in size from 1 to 1.5 centimeters. No gross structure could be recognized. The section was uniformly white in color.

Microscopical description: Sections at different places showed a fairly uniform picture. Places of extensive necrosis were present. The fibrous tissue was quite dense in places, and there was some hyalinization. These areas showed few cells. At other points, the cellularity was quite marked. There was no uniform polarity, and there was moderate variation in size and shape of cells. The nuclei stained deeply and there was a distinct tendency to increased mitosis. Spindle and round cells of different sizes were most abundant with the spindle type predominating. Above structures lay in moderately dense connective-tissue reticulum. Numerous blood vessels were distributed through the tissues. Some had well-formed walls, while others showed only an indistinct layer of endothelium. About these channels the cells had the appearance of being combed out in radiating lines. There was invasion of the blood vessels, but this was not marked. Diagnosis: spindle celled sarcoma.

The patient was admitted the third time March 4, 1924, complaining bitterly of a constant pain extending down the leg, most marked posteriorly. The pain was intolerable at times. Several X-ray treatments had been given without relief.

Special examination: The patient was rather pale but the nutrition was good. There was considerable induration in the region of the old wound. It extended deeply into the posterior aspect of the thigh.

Operation. The patient had been having a great deal of pain in the foot and leg. An alcoholic injection of the nerve was declined by the patient and hip joint amputation was proposed. The femoral artery and vein were tied in Scarpa's triangle, the muscles were then divided and the head of the bone disarticulated. There was little loss of blood but the patient was transfused to combat the shock.

Pathological report. Gross description: There was a dense fibrosis in the region of the previous operation with infiltration of the surrounding muscles. In the center of this fibrotic mass there was a considerable amount of soft, grey, necrotic tissue surrounding the sciatic nerve. A firm irregular tumor of the nerve trunk about the size of a hen's egg was located in the center. The growth was roughly spindle shaped. The surface was nodular and fairly dense. Section surface showed the nerve to be completely infiltrated at this point. The growth was whitish in color and showed numerous necrotic areas. The growth proper was 4 centimeters in length and 3 centimeters in cross section. The outer surface showed an eroded area the size of a quarter where it was continuous with the growth extending into the muscles.

Microscopical description: Sections of the tumor showed a marked widespread proliferation of immature connective tissue cells. Marked variation in shape and size and staining properties were observed. Many giant cells were present. Irregularly shaped cells with an extensive amount of cytoplasm and large nuclei showing mitotic figures were present. There was no uniformity of cell type. A few characteristic spindle cells were seen. On the outer portion of the section, the epineurium of the nerve could be seen. Numerous small nerve tracks were likewise included in the section. One of the smaller arteries showed cells within the lumen. The above described cells showed areas in which they had broken through the epineurium of the large nerve. Sections at other levels showed marked necrosis. Diagnosis: mixed celled sarcoma invading nerve and small blood vessels.

Convalescence was delayed by deep suppuration and sloughing of the wound. Discharged May 12, 1924. The patient died during the latter part of June, 1924, with extensive metastases of the lungs and pleura.

CASE 4. C 251. A white female, aged 33, entered the hospital January 16, 1921, complaining of a tumor which she first noticed about 10 years ago on the inner aspect of her right thigh. At this time, it was about 10 centimeters in diameter. It grew rather rapidly over a period of 7 or 8 months and became painful. It caused much discomfort and inconvenience. A fatty tumor, weighing 10 pounds had been removed at another hospital. The tumor recurred and grew slowly over a period of 3 or 4 years, and almost reached a size of the former growth. A second fatty tumor, weighing 6 pounds, was removed at another institution. This tumor caused no symptoms other than the inconvenience due to the size. The present tumor made its appearance about one and one-half years ago. It had grown more rapidly during the past 4 or 5 months. There had been no pain or loss of weight. The tumor felt heavy but there was very little disturbance in locomotion.

Physical examination was essentially negative, but special examination showed on the medial aspect of the right thigh a tumor mass about 20 centimeters in diameter It was quite firm and not fluctuant. It did not pulsate. It was not tender and was freely movable. There was no enlargement of the inguinal glands and there were no masses in the abdomen.

Operation. In the adductor region of the upper portion of the right thigh, there was a large mass consisting of two lipomata, each about the size of, or larger than, a fist, and several smaller ones. Search was made for additional growths but none was found. The wound was drained.

Pathological diagnosis: Lipoma.

Second admission, July 12, 1922.

Interval history. The growth returned insidiously and became larger than ever before. The only symptons were those of discomfort and inconvenience due to the size of the tumor.

Physical examination revealed in the right thigh, occupying the posterior, medial and lateral aspects, a large tumor mass, extending from the pubes on the medial aspect and from 3 inches below the great trochanter on the lateral aspect to the middle of the thigh. It was about 30 centimeters in diameter, relatively fixed in the soft parts and not freely movable over the bone. The consistency was firm in places and soft and doughy in others, suggesting a lipoma. No fluctuating areas were found.

Operation. A curved incision was made over the mass. Large diffuse masses of fatty tissue, which were not well encapsulated, were removed. Extension between the muscles was marked, and numerous isolated tumors were removed. The muscles were not directly infiltrated. The wound was drained with rubber tube.

The prognosis was bad. The size of the thigh was not markedly reduced by the operation.

Pathological report. Gross description: Tumor masses weighing in all 2,398 grams were received. They varied in size from a large grapefruit to a plum. Most of these were apparently fatty tissue, being yellow and soft in appearance. A portion presented a degenerated appear-

ance, being soft, friable, and greyish yellow. Throughout these areas were numerous small nodules which were quite firm, white, and glistening on section. There was also a considerable quantity of blood-tinged tissue.

Microscopical description: Sections through the various portions of the tumor masses showed them to consist of immature fibroblasts following the blood vessels and arranged in broad bundles and narrow columns. In other areas, fibrosis had occurred, as shown by the mature fibroblast and in still other areas, fatty tissue predominated as was evidenced by the vacuolated spaces held in a fine connective tissue stroma. There were a few poorly defined blood sinuses. The histology is that of a malignant tumor.

Diagnosis: Lipofibrosarcoma.

Some suppuration of the wound delayed convalescence. Following her discharge from the hospital, the patient had intensive deep X-ray therapy which resulted in mild burns and a slight reduction, which was only temporary, in the size of the tumor. During the last few months of her life, the tumor returned. The skin became ulcerated; infection spread to the interior and resulted in an extensive necrosis of a very foul nature. She died in December, 1923. There was no clinical evidence of distant metastases, although extreme cachexia prevailed.

CASE 5. E 4993. A white male, aged 38 years, entered the hospital December 7, 1924, complaining of a swelling in the region of the right knee. Twenty years ago, he wrenched the knee and used crutches for several weeks. For the following period of 5 years he had no symptoms except a tender spot and an occasionl pain in the knee after exercise. Movement was not limited and there was no swelling. Two years ago, the joint began to enlarge. This was most marked on the inner side. The growth had been slow but continuous up until the past month when it became more rapid. At times the joint had been red and painful. The pain was relieved by hot compresses. Nine months ago, another small mass appeared above the previous one. It had been growing slowly. There had never been any limitation of movement. He had had a tender spot in the right elbow for the past 3 months. There were no other joints involved.

Physical examination was negative aside from special examination which showed an ovoid swelling about 7 by 10 centimeters on the inner aspect of the right knee joint. The skin was tense but movable over the growth. The growth was fixed to the deeper structures and was moderately tender on pressure. The bony prominences of the knee could not be palpated. However, there was a suggestion of thickening of the upper end of the tibia. On the upper margin, there was a small fluid area which changed in size when the knee was flexed. There was no impairment of joint motion. A number of enlarged, firm, palpable glands were found in the neck, groin, and left epitrochlear region.

Operation. The major portion of the tumor was subcutaneous and it was completely dissected out without any important structures being encountered when the knee joint was opened.

Pathological report. Gross description: The specimen showed a soft, boggy tumor which appeared well encapsulated and measured about 5 centimeters in diameter. The outline was somewhat irregular. The section surface presented a glassy, translucent, slightly bulging, buff-colored tissue with numerous small areas of doughy consistency, and other zones of cyst formation. A small mass of fibrous tissue was attached to the above described structure. It showed a number of small hæmorrhagic areas.

Microscopical description: Sections of tissue from the knee tumor showed a variety of connective-tissue elements. There were zones composed of moderately dense fibrillar connective tissue. Elsewhere, there was a loosely woven network of cells with fine reticular processes or branches. There were a number of thin-walled blood vessels. Nowhere were there extensive areas of fat, but here and there were vacuoles the size of an adult fat cell. These empty spaces probably represent fat cells from which the fat material had been removed by solvents. There were numerous areas which were quite cellular. At these points the cells were quite variable in size and shape; the nuclei took a deep stain, but there was no prominent tendency to mitotic division. There was nothing microscopically to suggest an inflammatory origin.

Pathological diagnosis: lipofibromyxosarcoma.

TREATMENT

Even though there is much to be desired, surgical procedure offers the best chance of relief that we have at our disposal at the present time. Left alone, these tumors proceed to the inevitable end and cause death by their malignant properties or by mechanical embarrassment of the vital functions, and sometimes by starvation due to their parasitic nature. That malignant change takes place regardless of surgical intervention is borne out by numerous cases on record which have been studied at necropsy without ever having been subjected to operation. X-ray, with improved technique, may prove beneficial as it did in one of our cases. However, it was intensely used in three other cases with no avail. The end-result in our case which was benefited is yet to be seen. Case 5 was given two series of X-ray treatments and, when last seen 8 months after the operation, there was no clinical or X-ray evidence of a recurrence.

It is difficult to explain the frequent recurrence of so perfectly an encapsulated tumor which, unless of great size, shells out so easily, and which early has such a benign appearance. A significant fact in our own cases and in numerous other recorded cases is the existence of separate lobules of smaller size in the region of the main tumor. It is quite likely that many of these smaller tumors exist in recesses not explored, or are so small as to go undetected by the operator. There may be islets of undifferentiated tissue, hæmatomata, scattered about the site which are stimulated to active growth after the removal of the primary tumor. That the character of the differentiation of these rests should vary widely from simple lipomata to myxomatous and sarcomatous neoplasms at different operations is not to be wondered at. The fact that there are varied areas in the same tumor may be explained by a fusion of several of these elements which proceeded in different directions in their development. In this it would be unnecessary to assume a metaplasia of tissue.

Whether the foregoing opinion is correct or not, it constitutes a good working hypothesis on which to base the treatment of malignant fatty neoplasms. Simple enucleation is not sufficient—one must go farther and extirpate thoroughly all the surrounding fat, muscle, and other tissue, in so far as this is feasible. In other words, deal with them as one does with other tumors of a malignant nature. One hesitates to propose the amputation of a limb when a fatty tumor of this type is encountered, thinking perhaps that all sources for a recurrence have been removed by a thorough local operation. In the present state of our knowledge, it is our judgment to follow thorough extirpation with X-ray. Until the results and observations in a larger number of cases are recorded so that the course of malignant fatty neoplasms can be predicted with certainty, one is not justified in extremely radical treatment. X-ray is of no avail in the advanced cases, but if used early and intensively after the initial operation it may prove beneficial.

The intimate relationship of the retroperitoneal tumors with the great vessels, the mesenteric vessels, the kidneys, the ureters, spleen and gastro-intestinal tract offers many obstacles to their complete extirpation. Instances of injury to the gut or its blood supply are common in the literature, and often so extensive as to require resection. The vena cava has been torn and sutured and in one instance the vena cava and abdominal aorta have been included in the ligature in a desperate effort to arrest hæmorrhage. The blood supply of the tumor itself is usually in a small pedicle which may be secured after the tumor is removed.

Approach to the retroperitoneal regions may be made extraperitoneally through a lumbar incision or transperitoneally through a midline or a rectus incision of ample dimensions. Both have their advantages in selected cases but for all around exploration and ease of procedure, we believe the abdominal incision to be superior. Incision is then made through the peritoneum on the outer side of the colon and the anterior investment of the tumor stripped medially and with its intact blood supply. Careful and tedious dissection of the deeper portions is then carried out. Tongue-like projections may extend into recesses behind important structures. It would be highly desirable, if possible, to remove all of the fat down to the lumbar muscles after the tumor is enucleated. Careful hæmostasis of all oozing points should be attended to. If this can be satisfactorily done, it may be feasible to close without drainage as advocated by Masson and Horgan. It is quite essential to obliterate the cavity as nearly as possible to prevent an accumulation of blood and serum which might become infected. Drainage should be provided if there is any fear of an accumulation of blood. Hæmatomata of considerable size may form if this precaution is not observed. Drainage is especially desirable in infected cases. When haste is essential to complete the operation, tamponage may be practiced to control general oozing.

Postoperative complications depend largely on the trauma incurred by the various structures, such as necrosis of gut when the blood supply has been damaged, resulting in perforation and peritonitis. Infection of hæmatomata may occur. Postoperative shock is extremely likely in a difficult and prolonged operation. Death from hæmorrhage has been reported. Intestinal obstruction may be encountered, but instances of this have not been recorded. The operative mortality in all the cases recorded by von Wahlendorf was 25 per cent. Cases operated upon since 1910 show a mortality rate of 14 per cent. Modern surgical technique is largely responsible for this reduction.

PROGNOSIS

We believe that the malignant nature of these tumors is not generally appreciated by the surgeon and too little emphasis has been laid on this phase of the subject in the cases recorded. Incomplete reports based on single operations and unsatisfactory follow-up leave the surgeon with a false sense of security. The location and the size of the tumor coupled with the feasibility of a radical extirpation with the surrounding structures, such as muscle, fat, etc., will of course influence the outlook. Our experience justifies the placing of these tumors in a group which is highly malignant and the recurrence of which with destructive properties is only slightly less striking than sarcomata of other types.

Of 153 cases reported by von Wahlendorf and permitting of classification, 70, 46 per cent, were recorded as pure lipomata. Eighty-three, 54 per cent, were mixed tumors. Of the mixed type, 31, 20 per cent, were considered fibrolipomata; 16, 10 per cent, as myxolipomas; 15, 10 per cent, fibromyxolipomata; 21, 14 per cent, showed distinct sarcomatous change. Of 113 cases, including all types which were operated upon, 29 died. Only 15 recurrences are recorded. In 9 cases there was no report, thus leaving 60 cases, 54 per cent, classified as cured. He subjects these figures to a critical analysis and concludes that they are far too high and quite misleading.

For instance, he points out in this series that of 21 cases showing sarcomatous change, only 3 were reported with recurrence, a result quite unheard of in view of our knowledge of this neoplasm. He further points out that in some of these sarcoma cases, complete removal was impossible, yet 18 are regarded as cured, because of incomplete data and unsatisfactory follow-up. Of the 15 recurrences, 5 were reported as lipomata, 3 as fibrolipomata, and 3 as fibromyxolipomatas, and 6 not sufficiently described to classify. Analysis of our own cases and a study of reported cases indicate an extremely grave outlook.

SUMMARY

We have completed a fairly extensive review of the literature and added our own observations in five cases of liposarcoma. Very often lipomata found in the retroperitoneal and intermuscular regions pursue a definitely malignant course, recurring as fibrolipomata or fibromyxolipomata and finally as definite liposarcomata. Occasionally subcutaneous lipomata manifest the same tendency. The highly malignant nature of these tumors is not properly appreciated. They should be dealt with radically, as in the case of other malignant neoplasms, by thorough extirpation followed with X-ray.

BIBLIOGRAPHY

ADAMI, J. G. On retroperitoneal and perirenal lipomata. Montreal M. J., 1896, xxv, 526.
ALSBERG. Quoted by Hartwig.
BORK, L. Beitrag zur Kenntniss der Nierenkapselgeschwuelste. Arch. f. klin. Chir., 1901, lxiii, 935.
BUROW, DR. Lipoma myxomatodes telangiectaticum des Oberschenkels. Arch. f. path. Anat. u. Physiol., 1867, xxxviii, 565.
DELAMATER, J. Mammoth tumor. Cleveland M. Gaz., 1859, i, 31.
EWING, J. Neoplastic Diseases, 2d ed., 1922, p. 183.
FOERSTER, PROF. Arch. f. path. Anat., 1857, xii, 197.
GARDNER, W., and ADAMI, J. G. Retroperitoneal lipoma (lipoma myxomatodes). Montreal M. J., 1900, xxix, 417.
GRAWITZ. Ueber Entwicklung der Nierentumoren aus abgesprengtem Nebennieren-Gewebe. Deutsche m. Wchnschr., 1884, x, 719.
GREENSFELDER, L. A., and BETTMAN, R. B. Retroperitoneal lipoma. Surg., Gynec. & Obst., 1923, xxxvii, 468.
HARTWIG, C. Lipoma and liposarcoma of the kidney. Am. J. Urol., 1907, iii, 45.
HERTZLER, A. E. The Peritoneum. vol. ii, p. 786.
HIRSCH, E. F., and WELLS, H. G. Retroperitoneal liposarcoma. Am. J. M. Sc., 1920, clix, 356.
HOLMES, W. R. Retroperitoneal perirenal lipomas. J. Am. M. Ass., 1920, lxxv, 1065.
JACOBSON, V. C. A study of lipomyxosarcoma. J. Cancer Research, 1921, vi, 109.
JOHNSTONE, R. J. Recurrence of retroperitoneal lipoma. Brit. M. J., 1907, ii, 950; A case of retroperitoneal fibrolipoma. Brit. M. J., 1905, ii, 1452.
KEENAN, C. B., and ARCHIBALD, E. W. Fatty tumor of kidney suggesting a metamorphosis of adrenal cells into true fat. J. M. Research, 1907, xv, 121.
LECÈNE, P. Les tumeurs paranephritiques. Rev. de chir., 1919, lvii, 684.
LITTLE, H. C. A spectacular case of lipomyxoma. J. Am. M. Ass., 1913, lx, 899.
MCCONNELL, G. Recurrent liposarcoma of kidney. J. M. Research, 1908, xix, 225.
MCFARLAND, J. Surgical Pathology. 1924, p. 251.
MASSON, J. C., and HORGAN, E. J. Retroperitoneal lipomas. Med. Clin. N. Am., 1921, i, 1451.
MORGAGNI, J. B. The Seats and Causes of Diseases, 1769, vol. ii, Letter 39, pp. 364–367.
PROESCHER, H. E., and MEREDITH, E. W. Multiple myxocholesto-lipomata. Surg., Gynec. & Obst., 1909, ix, 578.
ROBERTSON, H. E. Lipoma myxomatodes. J. M. Research, 1916–17, xxxv, 131.
SCHILLER, H. Lipomata in sarcomatous transformation. Surg., Gynec. & Obst., 1918, xxvii, 218.
SELTER. Quoted by Hartwig.
SENFTLEBEN, H. Myxoma lipomatodes. Arch. f. path. Anat. u. Physiol., 1858, xv, 336.
VIRCHOW, R. Myxoma lipomatodes malignum. Arch. f. path. Anat. u. Physiol., 1865, xxxii, 545; Ein Fall von boesartigen, zum Theil in der Form des Neurom auftretenden Fettgeschwuelsten. Arch. f. path. Anat. u. Physiol., 1856, xi, 281; Notiz ueber den Glaskoerper. Arch. f. path. Anat. u. Physiol., 1852, iv, 468.
VON WAHLENDORF, A. L. Retroperitoneal Lipomas. Arch. f. klin. Chir., 1821, cxv, 741.
WALDEYER, W. Grosses Lipo-Myxom des Mesenteriums, etc. Arch. f. path. Anat. u. Physiol., 1865, xxxii, 543.
WARTHIN, A. S. Fibrolipoma of the kidney. J. Path. & Bacteriol., 1897, iv, 404.

PRELIMINARY PAPER ON IMPROVEMENT OF SPEECH IN CLEFT PALATE CASES

By H. L. D. KIRKHAM, M.D., F.A.C.S., Houston, Texas

OPERATIONS for the correction of cleft palate have been brought to a point today where we can, with careful technique, reconstruct a very fair to very good anatomical palate. However, it is an admitted fact by all doing any amount of palate work that the functional results, as regards speech, are far from good and in most instances very bad.

The reasons heretofore given and generally accepted for poor speech following palate operations are, first, that the reconstructed palate is usually too short to extend back and shut off the nasopharynx, or second, that the musculature has been so much interfered with that the soft palate cannot be retracted. However, we repeatedly find that patients with palates which are extremely short have reasonably good speech, and vice versa we find that patients with palates which are long and pliable have poor speech. It is also true that the severing of muscles of the palate does not have any marked effect upon the pliability of the palate. Again in a certain proportion of patients otherwise normal who have experienced tonsillectomy and removal of adenoids we find a temporary development of speech closely resembling the speech of a cleft palate patient. In such patients the palate certainly has not been shortened or its musculature interfered with enough to account for the speech. The facts mentioned led me to the conclusion that, while a long palate is ideal and is a large factor in improving speech, there must be some important factor which is being overlooked. For some time I have observed that in a large majority of cleft palate cases, especially in older children, there is an abnormal development of the superior constrictor muscle of the pharynx. At first no particular significance was attached to this fact. Figure 1 shows the anatomy of the superior constrictor and the manner in which it forms practically a sphincter for the nasopharynx. Recently, through the courtesy of Sir Arthur Keith, I have had the opportunity of measuring at the Hunterian Museum of the Royal College of Surgeons, London, the anatomical landmarks in normal palates at different ages and I was able to determine the normal pal-

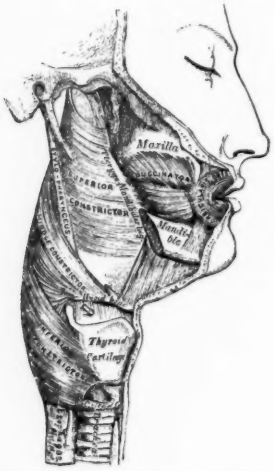


Fig. 1. Lateral view of the anatomy of the superior constrictor muscle (Gray).

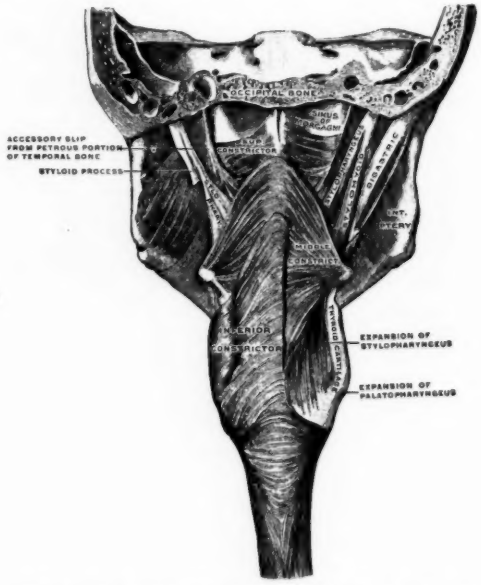


Fig. 2. The superior constrictor muscle of the pharynx as viewed from behind (Gray).

[1] Presented before the Texas Surgical Society, April, 1926.

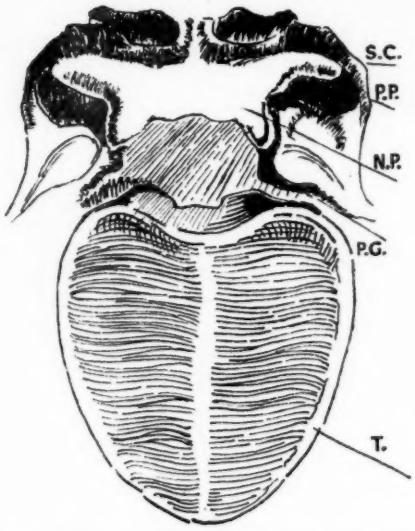


Fig. 3. Cross section of the nasopharynx just above the level of the uvula. S.C., Superior constrictor; P.P., palatopharyngeus; N.P., nasopharynx; P.G., palatoglossus; T., tongue.

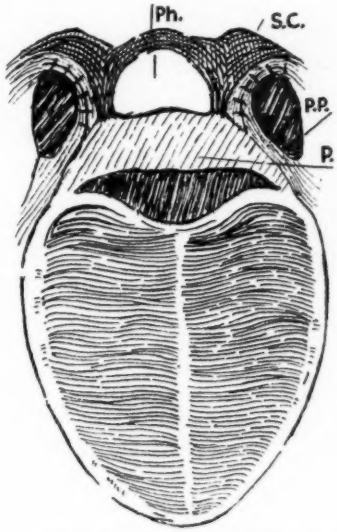


Fig. 4. Showing diagrammatically a cross section of the point where the superior constrictor was sutured to the posterior surface of the palate and the palatopharyngeus muscles. Ph., Pharynx; S.C., superior constrictor; P.P., palatopharyngeus; P., palate.

ate as far as that could be done. By checking these measurements on cleft palate cases of approximately the same ages, we found that the hamular processes were distinctly wider in palate cases than in the estimated normal, depending upon the width of the cleft. This, together with the overdevelopment of the superior constrictor which has its origin from the pterygoid processes of the sphenoid, led me to the conviction that the superior constrictor muscle has far more bearing than has heretofore been thought on the production of speech, or rather voice tone.

It is necessary to make a distinction between speech and voice tone. A large element in the production of the former is the tongue, and we find many letters and sounds which these patients cannot make due to the lack of functional development or education of the tongue. Careful training can undoubtedly correct this to a large extent provided the patient will conscientiously cooperate and is not too tone deaf to his own voice. The production of voice tone is entirely a matter of ability to close the nasopharynx to the correct degree, and makes the difference between a pleasing tone and a harsh nasal tone. It is this improved voice tone at which we aim and reliance must still be placed upon training to improve the actual production of sounds requiring the lip and tongue.

Injury to the superior constrictor muscle especially along its upper border during the removal of adenoids is a relatively easy accident, and could explain the nasal tones that some patients develop. The hypertrophy of the superior constrictor in cases of cleft palate can be explained by the fact that this is the only muscle the patient can utilize in order to attempt to close the nasopharynx. The other muscles, with the exception of the palatopharyngeus and the palatoglossus, on the lateral walls of the pharynx, are cleft. The reason the superior constrictor, in spite of its overdevelopment, cannot contract enough to close the nasopharynx is probably due to the fact that its origins, the pterygoid processes, are in fact farther apart. While this expansion of its origin is not great, yet a slight difference would markedly impair the sphincter-like action of this muscle.

The only reference that I have been able to find in regard to the superior constrictor is in the last edition of Blair's *Diseases of the Mouth and Jaws*. Blair mentions the same observation that I have made, namely, that there is an overdevelopment of the superior constrictor in many cleft palate cases. He further goes on to say that it is in these cases that speech results are better following operation, deducing as his reason that the

patient has been able to educate the superior constrictor to such a degree that the same perseverance makes it easier for him to educate the other muscles of the palate after operation. This deduction, if my theory is correct, is not true, for I believe that the normal importance of the constrictor in the production of speech, or rather voice tone, has been overlooked, and its expanded origin in cleft palate together with a short or less pliable palate accounts for its lack of complete action.

With the above facts, observations, and deductions, I became convinced that if a method could be devised by which the superior constrictor could be shortened, preferably allowing it to act upon the posterior part of the palate, the closure of the nasopharynx would be very much facilitated, and consequently speech should be improved. A short time ago I operated again on a child 6 years old upon whom I had previously repaired a palate, and had obtained a rather short palate. I freed the upper border of the superior constrictor on each side of the pharynx and sutured it to the posterior surface of the palate and palatopharyngeus which, of course, were denuded. Figure 3 shows a cross section of the nasopharynx just above the level of the uvula. The band-like superior constrictor can be seen passing across the back of the nasopharynx. Figure 4 shows diagrammatically on cross section where the superior constrictor was sutured to the posterior surface of the palate and the palatopharyngeus muscles. Thereby the nasopharynx was made narrower, and the action of the superior constrictor was upon the posterior surface of the palate with a consequent tendency to retract it and close off the nasopharynx still more. The immediate result in this case, the next few days, was a striking improvement in voice tone. On the fourth day, however, I was much chagrined to find that the child spoke just as badly as before the operation. However, on examination it was found that the sutures had pulled out during the night.

The immediate results in this case still further convinced me that some method of shortening the superior constrictor along its upper border will be the keynote to improvement in speech in palate cases. It remains to be determined at what point it is best to free the constrictor so that it can be shortened without tension, also how far it is desirable to free it.

This preliminary paper is presented at this time with the idea that should it have any merit it can be tried on a larger number of cases by those who care to test it out, and I am convinced that the superior constrictor of the pharynx takes a much greater part in the production of voice tone than has been heretofore acknowledged.

USE OF THE SETON IN REPAIR OF A TORN OR STRICTURED URETHRA

A New Method with a Report of Two Cases[1]

By GOLDER L. McWHORTER, M.D., Ph.D., F.A.C.S., Chicago
Assistant Clinical Professor in Surgery, Rush Medical College of the University of Chicago

THE difficulty in obtaining satisfactory union of the ends of a ruptured or completely strictured urethra is experienced by the majority of surgeons. The use of a seton over a long period of time for the purpose of maintaining the lumen of the urethra while permitting epithelialization and healing of the soft parts is believed to be a valuable principle, not previously practiced in this branch of surgery. The following cases illustrate its use in rupture of the urethra and stricture of the unfavorable traumatic type.

Case 1. J. M., male, aged 7 years. Final diagnosis: Fracture of both rami of the pubic bone; rupture of prostatic urethra and extensive extraperitoneal rupture of neck and base of bladder.

Patient entered the Presbyterian Hospital March 30, 1924. The complaints resulted from a crushing injury to the pelvis 28 hours previously, extreme pain over lower abdomen, pains through the pelvis, inability to urinate, and complete prostration. The child was crushed over the pelvis between the tail board of a truck and a tree. He was completely disabled and carried home. In spite of the evidence of severe injury and inability to urinate, although seen by a physician, the child was not given relief. He was given an enema that night with a good return and no blood, but gradually became worse. There had been no bloody discharge from the penis following the injury. The previous history was negative. The child had always been an active boy.

Physical examination. On entrance to the hospital, the face appeared drawn, almost cadaverish with an ashen gray hue and sunken eyes. The respirations were very rapid. The pulse was rapid and the child seemed almost *in extremis*. The abdomen was moderately distended but distention was limited to the lower one-third. It was acutely tender and rigid with marked muscle spasm. There was subcutaneous ecchymosis over the symphysis on both sides of the abdomen. The child was not able to move the legs without excruciating pain. There was no evidence of injury to the penis, scrotum, or perineum. There was too much pain to make a rectal examination. It was a Sunday evening and it was impossible to get an X-ray. A diagnosis of an intrapelvic rupture of the bladder was made and the child was prepared for an emergency operation.

Operation. Ether anæsthesia. I made a suprapubic incision and on going through the prevesical fascia, encountered bloody turbulent urine in large quantities. The bladder was contracted, but lying rather high. The fundus was opened and then a large tear could be easily seen extending completely across the prostatic urethra at the base and extending up irregularly on the sides of the bladder. The tear admitted three fingers. A No. 10 F. catheter was inserted through the penis and brought out into the bladder. A long piece of waxed skin silk was sutured through the bladder end of the catheter and brought out through the fundus opening together with a large tube drain (Fig. 1). Two soft collapsible rubber drains were put into the space of Retzius, one on each side. There was no evidence of intraperitoneal rupture and the wound was closed about the tubes.

Postoperative course. Outside of local swelling of the penis, the convalescence was quite smooth. Five days after operation the œdema of the penis necessitated removal of the small rubber catheter, and making a dorsal incision of the foreskin for a paraphimosis. In removing the catheter the attached waxed silk thread was drawn out through the urethra and the other end extending out from the fundus of the bladder and the abdomen was tied to it, forming a seton (Fig. 2). The swelling of the penis subsided gradually. There was some pus in the urine but the bladder was irrigated daily as long as the opening permitted it.

Sounds were first passed 38 days after this operation, under ethylene anæsthesia. It seemed advisable to use filiforms with screw sounds having a short curved shank. By putting traction on the silk thread a filiform could be passed into the bladder more easily. A size No. 15 F. sound was passed. The silk seton did not interfere with passing sounds but seemed to help guide the sound into the bladder. This same method in the passage of the filiform guide screw sounds was used four more times during his hospital stay, or, about every 9 days. The sounds were used up to a No. 21 F. The abdominal wound gradually closed around the silk seton. The child voided first on the fifty-ninth day. The silk seton was removed on the sixty-fifth day after the urethra was found to stay well dilated and the child was voiding well. The abdominal wound scarcely discharged the last 2 weeks the seton was in place and healed promptly after its removal. The child was discharged as well on the eighty-fourth day. Sounds were passed again 1 month later and have been passed about every 6 to 9 months since.

After almost two years this boy is still well and there is completely normal bladder function. Laboratory examination of the urine was negative. On account of the small size of the child, the largest sound passed has been a No. 21 F. The sounds with screw filiforms have been used throughout on account of their short shank. However, I passed an ordinary No. 18 F. Van Buren sound after the last dilatation or about 1½ years after the injury. There has been no tendency to stricture formation.

Case 2. H. R., male, age 64 years. Final diagnosis: Impassable stricture of the membranous urethra and base of the bladder, following a suprapubic prostatectomy and one previous operative attempt at repair; persistent suprapubic urinary fistula.

This patient complained of a persistent suprapubic fistula with inability to urinate. At times when the fistula would close for a few days the patient would be able to strain and pass some urine through the urethra, but he always had frequency and pain. The patient was operated upon elsewhere about 1 year previously, following symp-

[1] Read before the Michigan State Medical Society at Kalamazoo, March 16, 1926.

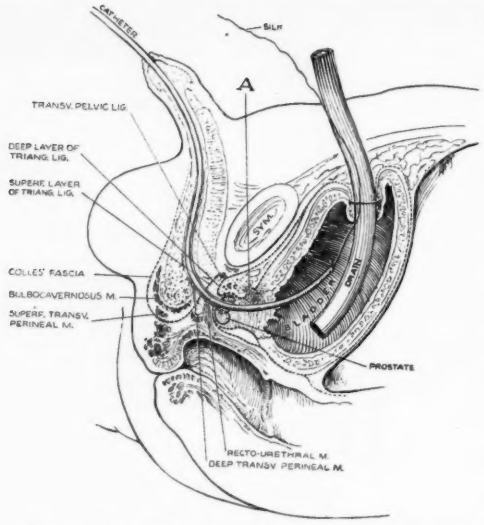


Fig. 1. Silk thread sutured to the end of a catheter in case of rupture of the urethra and the base of the bladder. The important anatomical layers are labeled.

toms of an enlarged prostate, which was removed. Following this, the bladder neck closed over with scar tissue. He was re-operated upon for this stricture 6 weeks later by his doctor who forced an opening through a mass of scar tissue and left a catheter in for 2 weeks. Sounds were passed a few times, but the patient was never able to void normally after the prostatectomy.

About 10 months after the prostatectomy he developed an acute epididymitis and a suppurating sinus formed in the scrotum. He said that about 30 years ago he had suffered from this same trouble following an acute urethritis. When a child he had infantile paralysis and the left leg was always weak. He has had a goiter for many years. Otherwise his history and habits are negative. He has three healthy children.

Physical examination. Slightly emaciated male of about 64 years. There was a suprapubic scar with two openings from which urine came. There was no hernia. There was a suppurating discharge from a sinus in the scrotum, and the epididymis of the left testicle was much enlarged. On rectal examination, no prostate or tumor could be palpated. There was nothing else on examination pertinent to this trouble. I treated him for the cystitis and epididymitis for the next 2 months before attempting to restore bladder function. Preliminary examination showed the urine contained large amounts of pus and a trace of albumin. The phenolphthalein output was 40 per cent in 3 hours. The blood was fairly normal. Roentgenograms of the urinary tract were negative. It was impossible to pass sounds or the finest filiforms, due to obstruction in the region of the membranous urethra.

Operation. October 19, 1925. I excised the suprapubic scar and opened the bladder with difficulty on account of the scar tissue. No urethral opening could be found on the bladder side. It was feared that forcing a sound into the bladder from the penis might make a false passage apart from the normal position. One previous attempt had resulted disastrously elsewhere and it seemed advisable for me to make a perineal urethrotomy in order to place the new opening accurately. This was done and with one hand in the bladder for a guide, I made an opening through the scar tissue from the perineal part of the urethra into the bladder. There was apparently complete obstruction. A mushroom catheter was passed through the penis, and on into the bladder, through the new opening. A heavy braided silk thread was sewed into the bladder end of the catheter and brought out through the suprapubic opening together with a large tube drain. The abdominal wound was closed with drainage. The perineal wound was sutured tightly about the urethra except for a drain under the skin, and it healed by primary union. The convalescence was smooth. The bladder was irrigated daily.

The catheter was removed after 10 days, drawing the silk out through the urethra from the bladder and forming a seton (Fig. 2). There was a subacute urethritis about the catheter, and this was allowed to subside before sounds were passed. Ordinary Van Buren sounds were first passed alongside the seton 32 days after operation without any difficulty. They were passed about every 4 days until he left the hospital 46 days after operation. The silk seton was removed on the forty-third day, after the sounds had shown that the lumen of the urethra was well healed and did not tend to contract quickly. The patient returned for passing sounds up to No. 30 F. once a week for a month and then less frequently.

On January 21, 1926, I operated on the suprapubic fistula under local anæsthesia. This was 3 months after the operation for the reconstruction of the urethra. The silk suture due to some traction had enlarged the suprapubic opening forward and the epithelium had grown down to the bladder mucosa. The patient voided some urine but most of it came out through the fistula. The sinus tract was excised, the bladder mucosa was inverted and two rows of fine catgut were used to draw the soft parts together. The skin was closed with a few widely interrupted sutures. A retention catheter was put into the bladder.

The wound healed by first intention. The catheter was removed after 7 days, and the patient voided normally. He was discharged as well on the tenth day. Function was perfect; he could retain his urine all night and voided a big stream of urine. At this time there were only a few pus cells found in the urine and no albumin. He was instructed to return at regular intervals for the passage of sounds. One month later the patient had gained about 15 pounds and felt better than he had for years; he had also started to do light work, which he had been unable to do since the first operation. The microscopic examination of the sinus showed the surface lined with stratified squamous epithelium.

THE ANATOMY OF THE URETHRA

It is important to review briefly some features in the anatomy of the urethra and the fasciæ of the perineum, since the location and treatment of tears, strictures, urine extravasation, and infection are influenced by these relations. The urethra may be divided into three parts: pars cavernosa, pars membranacea, and pars prostatica.

The membranous portion is found between the two layers of the triangular ligament and is surrounded by the external sphincter. The prostatic portion lies on the pelvic side of the

ligament. Clinically, the posterior urethra includes the membranous and prostatic portions, while the anterior is the penile portion.

There are three important fasciæ in the perineum. They are the fascia of Colles and the two layers of the triangular ligament. Colles' fascia, which is the deep layer of the superficial fascia, fuses posteriorly to the inferior layer of the triangular ligament (Fig. 1) and extends over the superficial transverse perineal muscle. It is attached laterally to the ischiopubic rami, and anteriorly it is continuous with the under surface of the dartos of the scrotum. It then passes forward to form the suspensory ligament and fibrous sheath (Buck's fascia) of the penis, covers the spermatic cord, and is continuous with Scarpa's fascia of the abdomen. It forms a superficial perineal space, which is continuous with that beneath Scarpa's abdominal fascia, while the latter fuses to the fascia of the thigh below Poupart's ligament. Posteriorly in the superficial perineal space there is a septum in the midline which tends to separate it into two lateral pouches but this septum gradually disappears near the scrotum. Extravasation of urine anterior to the triangular ligament in this space extends forward involving the perineum, the scrotum, and occasionally the penis, it then follows the spermatic cord up over the crest of the pubis and spreads out all over the abdomen.

The superficial or inferior layer of the triangular ligament is a firm fibrous membrane fixed at the sides to the tuberosities of the ischium and the ischiopubic rami along which it extends to the pubic arch. It forms the floor of the superficial perineal space.

The deep or superior layer of the triangular ligament is a continuation downward of the pelvic fascia first as the obturator and then as the rectovesical fascia. The part of this latter fascia lying in front of the deep transverse perineal muscles is called the deep layer of the triangular ligament.

The inferior and superior layers of fascia forming the triangular ligament fuse anteriorly, forming the ligamentum transversum pelvis (Spalteholtz, 17), above which runs the dorsal vein while the arteries and nerves perforate it near the sides. Between the two layers of the triangular ligament about the urethra is the musculus sphincter urethrae membranaceæ while behind this lies the musculus transversus perinei profundus and, just above the latter at right angles are the longitudinal fibers of the musculus recto-urethralis. The deep perineal space formed between these two layers of the triangular ligament is open posteriorly. Extravasation of urine from the membranous urethra may therefore extend backward into the ischiorectal fossa, through the superior fascia between the prostate and rectum, upward into the prevesical space, or it may leak through the inferior fascia of the triangular ligament and down into the superficial perineal space. Extravasation of the urine from rupture of the prostatic urethra may extend upward to the space of Retzius or backward to the prostate and rectum.

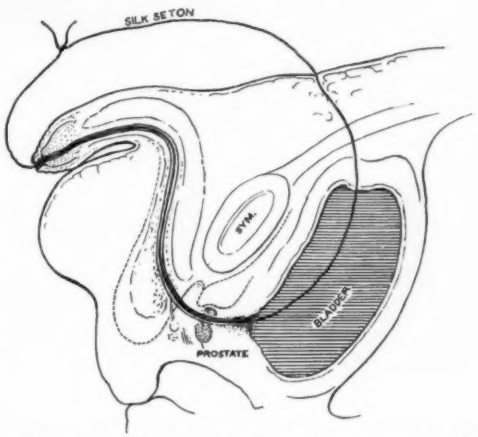


Fig. 2. The silk thread has been inserted through the urethra and the bladder and the ends tied together to prevent its removal.

Extensive rupture may also involve the bladder when there may be either intraperitoneal or extraperitoneal extravasation of urine.

CAUSES OF URINARY EXTRAVASATION

Barley and Huddy (1) studied 107 cases of urine extravasation. They found that in 65, it followed a periurethral abscess; in 20, traumatic rupture of the urethra; in 13, injury to the bladder; in 7, suprapubic puncture of the bladder; in 1, internal urethrotomy; and, in 1, it occurred in an infant. There were 11 cases of extravasation that occurred among 47 cases of rupture of the bulbous urethra due to falls astride. There was extravasation in the space of Retzius in all of the 9 cases of rupture of the urethra above the triangular ligament and they occurred as a direct complication of a fractured pelvis. Deansley (8), however, has reported intrapelvic rupture occurring by lateral compression without fracture of the pelvis. Barley and Huddy state that extravasation occurred in 5 cases of extraperitoneal rupture of the bladder; in 4 with intraperitoneal, and in 13 with combined lesions, but only 9 of

these followed trauma. They state that if the bladder is found even moderately distended, the rupture is below the vesical sphincter. Burrows (4) has called attention to the disastrous consequences following rupture of the urethra which will be avoided only by its recognition. The diagnosis is not easy, particularly in the rupture of the prostatic urethra or bladder in which a catheter may be passed and urine obtained from the collection in the prevesical space. He states that the differential diagnosis between intraperitoneal and extraperitoneal rupture is usually made after a suprapubic incision is made.

Vaughan and Rudnick (18) have recently utilized an original method of injecting air through a catheter followed by fluoroscopic examination or roentgenograms. They not only have been able to diagnose bladder rupture but also to differentiate between intraperitoneal and extraperitoneal rupture.

The type of trauma resulting from a fall astride a fence or other object, both Kidd (13) and Chetwood (6) found, tears the urethra across the bulbomembranous junction where it pierces the inferior layer of the triangular ligament by driving it against the pubic arch. Keyes (12) found a tear of the urethra of the bulb by a fall astride in 82 per cent of all cases of rupture. In crushed fractures of the pelvis Burrows (4) found the membranous urethra was usually torn across. As a general rule when the rupture was in the region of the triangular ligament he found the fluid came forward beneath the fascia of Colles. When it was above the intact inferior layer of the triangular ligament it extended backward into the ischiorectal fossæ. Only occasionally it spread back and upward into the deep pelvic cellular tissues, both groins, the space of Retzius or along the ureters.

Keyes (12) in 1923 found that tears of the posterior urethra resulted only from a fracture, dislocation, or strain on the pelvis. The membranous urethra was the part most commonly involved, together with tears of the triangular ligament, while the prostatic urethra was spared in all but the most extensive fractures. Deansley states that as a result of a fractured pelvis, the location of the rupture of the urethra is always above the posterior layer of the triangular ligament and not in the membranous portion. It is usually located at the apex of the prostate and is an intrapelvic rupture. He believes that the rupture is due to lateral compression of the pelvis with stretching of the soft parts and is not the result of laceration by the ends of the bone fragments.

TREATMENT

The indications for local treatment following any injury or obstruction of the urethra with or without extravasation of urine are: first, to provide adequate drainage to the bladder and for the extravasated urine or the infection; second, to maintain patency of the urethra until the granulating tissue has become covered with epithelium; and third, to prevent stricture by passing sounds.

The chief difficulty encountered is to maintain patency with approximation of the torn urethral ends, after a well executed emergency operation. Failure has resulted frequently, with early intractable strictures, obstruction, or with infection of the urinary organs. There are numerous illustrations in the literature of complete disability, repeated operations, and even death from failure to secure a patent functioning urethra.

To maintain patency of the urethra, the seton is left in for several weeks, that is, until the granulation tissue has become bridged with epithelium. A rubber retention catheter has been used by numerous surgeons for various periods of time following lesions of the urethra, but it is often impossible to insert or to leave until healing has occurred, which is especially true in the bad cases. Keyes (12) takes a decided stand against the use of a retention catheter, especially when used alone in rupture of the urethra.

Following any injury or operation, there is extensive œdema and, if used, the catheter must be changed frequently to prevent infection and obstruction by urinary sediment. In the presence of swelling of the periurethral tissues even a small catheter, due either to its relatively large size or to the elastic pressure, seems to interfere with healing. It increases œdema perhaps by strangulation of the blood supply and it permits poor drainage between it and the urethral walls, which favors extension of infection from the surface. Most authorities who leave in a retention catheter following operation advise its early removal. Martin and Thomas (14) remove it in 4 to 6 days. Cabot (5) removes it in 2 to 4 days.

There is an interval in the healing, of a varying length of time, which is dependent upon the presence of swelling, infection, or the extent of injury, before sounds should be passed. Davis and Traut (7) demonstrated the time for epithelialization of muscle tissue to occur by a skin flap sutured against it. They found that the malpighian layer makes the outward growth. It is followed by a layer of fibroblasts. The squamous layer develops later as the malpighian cells be-

come thicker. With small skin grafts, cavities were epithelialized in 20 to 40 days.

McArthur (15) has kept a small catheter through the ends of a ruptured common bile duct over a long period of time in order to obtain a satisfactory healing. Recently, he reported leaving a ureteral catheter through the torn ends of a ureter for 9 weeks and obtaining a satisfactory result.

In Kaufmann's (10) operation for converting an external parotid salivary fistula into an internal one, a rubber tube or heavy silk cord is inserted through the newly made tract and left in place 2 or 3 weeks, until epithelialization has well started.

Keyes says that an intractable stricture usually starts within 6 weeks. Sounds must be passed before this occurs.

If the ends of the urethra are not in apposition attempts to pass sounds may be fruitless or result in further injury. A distorted or obliterated urethra may necessitate further operations which may not prove successful. When sounds are forced through such a urethra the scar tissue is increased in amount, although the bad results of extensive injury or of improper treatment may not be evidenced for many years. Then, because of neglect in regular dilatation or due to a recurrence of an infection, there is an acute or chronic obstruction with an ascending infection which may destroy kidney function. Barling (2) operated upon a case similar to my Case 1. This patient had suffered a rupture of the urethra and the neck of the bladder following a fractured pelvis and was treated by a suprapubic drain. He saw him 5 years later, at the age of 20 years, with a persistent suprapubic fistula. In this case, there was an effect upon the penis and testicles which with other sexual characteristics were undeveloped. He first operated in an attempt to restore the urethra and obtained a rectovesical fistula. There was dense scar tissue about the neck of the bladder, and he considered further attempts useless. He then transplanted the ureters into the colon with success up to the time of the report.

Kaufmann (11) found a mortality of 14.5 per cent in 205 cases of ruptured urethra; however, when urinary infiltration occurred, it was 36 per cent.

The surgical treatment of rupture of the urethra above the triangular ligament or of the bladder with urine extravasation or infection, is preferably suprapubic incision with drainage of the infiltrated areas and of the bladder. At this time a catheter may be put into the urethra for a few days, and then withdrawn leaving a silk seton in place. A suprapubic incision may be necessary in addition to an external urethrotomy in case one fails to find the upper end of the urethra from the perineal incision. This retrograde catheterization from a suprapubic bladder incision together with the insertion of a seton or temporary catheter may be postponed for a few days when the patient is in serious condition from urine extravasation in the perineum and an emergency perineal operation done, with the wound left wide open for drainage as Kidd recommends. Drainage of the bladder by a suprapubic puncture or trocar is a very dangerous procedure. Barley and Huddy found 7 cases of extravasation of urine following puncture due to leakage about the wound when the bladder refilled.

The treatment of ruptured urethra in the bulbomembranous region is well summarized by Bevan (3), who states that external urethrotomy is necessary in case the rupture is extensive and is much safer for the patient than catheterization. It permits free exit of infection and drainage of urine. The patency of the urethra must be obtained by passing large sounds during the process of wound repair and later. Bevan believes that as a rule even in the absence of extensive infection, efforts at plastic repair and accurate suture of a ruptured urethra are of little value.

In the treatment of acute retention with diffuse phlegmonous perineal extension following a stricture of the urethra, Eisendrath (9) advises a suprapubic cystostomy with stab incisions over the infiltrated areas. He states that it is difficult to find the urethra through the perineum at this time and later when the swelling subsides he is often able to pass filiforms and sounds.

R. H. Russell has successfully resected a number of intractable strictures of the urethra with end-to-end suture. He states that external urethrotomy, which gives immediate relief in conditions of great urgency, has proved to be disastrous in a large number of cases by eventuating later in the most intractable kind of cicatricial strictures.

Because of these difficulties and since the external urethrotomy healed so successfully with the seton in my Case 2, I recommend its use following operation for either rupture or stricture of the urethra. A suprapubic cystotomy may be necessary, together with a perineal urethrotomy for the purpose of finding the upper end of the torn or strictured urethra by means of a retrograde bladder catheterization, or for more adequate emergency bladder drainage to be followed later by a perineal urethrotomy if indicated. In either

case the seton should be inserted. Whether a suprapubic cystotomy should be added merely for the purpose of inserting the seton, when only a perineal urethrotomy seems to be indicated, must depend upon the individual case and the experience of the surgeon.

While it is not necessary to use a linen or silk seton, since a very fine tube such as a ureteral catheter might do, a flexible seton will produce less distortion of the urethra. The seton should be left in place until all inflammatory reaction has passed, during the passage of sounds, and until epithelialization of the urethra has occurred.

BIBLIOGRAPHY

1. BARLEY and HUDDY. Extravasation of urine with especial reference to periurethral abscess. Brit. J. Surg., 1924, xii, 183.
2. BARLING, G. Intraperitoneal implantation of the ureters and the colon. Brit. M. J., 1907, i, 124.
3. BEVAN, A. D. Rupture of urethra. Surg. Clin., Chicago, 1918, ii, 1131.
4. BURROWS, H. Pitfalls of Surgery. 2d ed. New York: Wm. Wood and Company, 1925.
5. CABOT. Modern Urology, 1918.
6. CHETWOOD. Practice of Urology. 2d ed. 1913.
7. DAVIS and TRAUT. The production of epithelial lined tubes and sacs. J. Am. M. Ass., 1926, lxxxvi, 339.
8. DEANSLEY, E. Ruptures of the urethra, intrapelvic and perineal. Lancet, 1907, i, 81.
9. EISENDRATH, D. N. Urethral stricture. Surg. Clin. N. Am., 1925, v, 859.
10. KAUFMANN. Quoted by Forbes Hawkes. Johnson's Operative Therapeusis, vol. iii, 235. New York: Appleton & Company, 1915.
11. KAUFMANN. Quoted by Thomson-Walker. Surgical Diseases and Injuries of the Genito-Urinary Organs. New York: Funk and Wagnalls Company, 1914.
12. KEYES. Urinary Surgery. New York: Appleton & Company, 1923.
13. KIDD, F. Urinary Surgery. New York: Longmans, Green and Company, 1910.
14. MARTIN, THOMAS, and MOOREHEAD. Genito-Urinary Surgery. Lippincott & Co., 1920.
15. MCARTHUR, L. L. A new and simple repair of ruptured or strictured ureters. Surg., Gynec. & Obst., 1925, xli, 719.
16. RUSSELL, R. HAMILTON. Papers and Addresses in Surgery. Melbourne, Australia: Allan Grant, 1923.
17. SPALTEHOLTZ. Hand Atlas of Human Anatomy. Philadelphia: Lippincott and Company.
18. VAUGHAN, R. T., and RUDNICK, D. F. A new and early sign of ruptured bladder; a new method. J. Am. M. Ass., 1924, lxxxiii, 9.

THE PREPARATION AND MANAGEMENT OF THE SURGICAL DIABETIC

By GARFIELD G. DUNCAN, M.D., C.M., Philadelphia,

AND

INGLIS F. FROST, M.D., F.A.C.S., Morristown, New Jersey

RECENT statistical reviews (1, 2, 9, 12, and 13) have revealed the decreased risk attending surgical intervention in the diabetic. Diabetes itself presents no contra-indication to surgery; complications however may. This is one disease which must be managed with the collaboration of surgeon and internist. If this co-operation is not available, the greatest contra-indication to surgical intervention presents itself. It is not singular to find that some surgeons and even internists still view operative procedures upon these patients with the same hesitancy as they did in the pre-insulin days. It is for this reason in addition to our desire to record the facts which have led us to change our management of these patients, that we offer this paper. Failures in the very severe cases have been too frequent, but with increasingly good results, we feel disposed to describe the method to which we attribute the transition.

The details of the method adopted in dealing with this type of patient matter less than does the general principle of thoroughness. In an attempt to increase the reserve glycogen, Judd, Wilder, and Adams (7) prepare the patient by allowing 100 to 140 grams of carbohydrate daily for 3 to 4 days before operation, when such a delay is permissible. Insulin is increased to prevent glycosuria. When the patient returns from the operating room, insulin is given and glucose is administered by proctoclysis. Fruit juices and ginger ale are allowed early by mouth. It is the aim of these writers to have at least 75 grams carbohydrate metabolized in each 24 hours. Each voiding of urine is tested for sugar and acetone bodies. Any sign of acidosis is accepted as a danger signal. Ether administered as described by Fitz (3) has proved satisfactory although ethylene is being used more at the present time.

Jones et al. (5) discourage radical measures in making the urine sugar free before operation, believing that the glycogen reserve is thereby depleted. Fluids are given in liberal quantities. Two days prior to operation 80 to 100 grams of carbohydrate is contained in the diet, which is very low in fats. Two hours before operation 150 grams of orange juice is given, being preceded by 30 minutes by the usual morning dose of insulin. Glycosuria is allowed postoperatively. The urine is examined every 3 hours to serve as a guide in the administration of the insulin. Little attention is paid to the level of the blood sugar.

These cases under Foster's (4) care are kept free from glycosuria if possible, with hyperglycæmia not exceeding .200 per cent, and with no acidosis. In emergency cases it is inevitable that some degrees of acidosis may exist. The urine is examined every 2 hours during the postoperative danger period. Nitrous oxide, ethylene, or local anæsthetics are employed.

Pre-operatively Bauman (2) gives glucose and insulin as indicated, the former in a 5 per cent solution intravenously. Local anæsthesia or nitrous oxide are the anæsthetics of choice. Following operation bicarbonate of soda is given intravenously or by rectum. Insulin and glucose administration is based on the urine findings, each voiding being tested. Two to four liters of liquids per day or normal saline subcutaneously if necessary is given. The blood sugar level is seldom kept within normal limits during the healing process. In the obese the total calories are reduced to 1200 or 1500. Emergency cases received glucose and insulin during or immediately after operation.

Petty (10) gives insulin immediately before operation in the presence of glycosuria or hyperglycæmia, fluids by mouth until one hour before operation, liquids immediately after operation, by rectum, by hypodermoclysis or intravenously. He aims to have 1,000 cubic centimeters of fluids retained every 6 hours. The insulin dosage is governed by chemical data. Carbohydrates are given within 2 hours. Three to 5 hours following operation he considers the most dangerous period. He prefers to use spinal or local anæsthesia, or gas.

We will make no attempt to discuss in detail any of these methods. It is sufficient to mention the variance of opinion, with apparently good end-results in each instance following the accurate application of the chosen regime. However, emphasis might be laid upon certain observations

not covered by these articles. These are dealt with later.

In order to outline our different methods, we have chosen to illustrate the three groups by single case reports. The groups represented are (1) the poorly prepared bad risk patient, (2) the well prepared bad risk patient, and (3) the well prepared good risk patient.

Poorly prepared bad risk patient. A Jewish male, age 60 years, was seen on January 22, 1926. His chief symptoms were severe pains in the left foot, especially on the dorsum, and leg, general weakness, nausea, vomiting and dyspnœa. His present illness dates back 8 years when glycosuria was found in a routine insurance examination. He then weighed "over 200 pounds." No diet was adhered to until January 14 of this year when, after a slight injury to the first toe on the left foot followed by extreme pain in the toe and leg, he was placed on a low carbohydrate low calory diet. He was admitted to a private hospital January 18, where he was seen by one of us on January 22. The objective findings were: obvious toxæmia, mild Kussmaul breathing, acetone odor of breath, obesity, moist râles at base of each lung, no visible cardiac apex pulsation, force of heart-beat poor, frequent extra systoles, increased frequency (108), soft systolic murmur at apex, not referred, sounds of poor quality, heart enlarged to left (9 centimeters from mid-sternal line), liver just palpable below costal margin, abdominal and patellar reflexes absent. The entire left foot was slightly swollen, and there was hyperæmia of the first toe with extension proximally to the mid dorsum of foot. The toe was tense and slightly discolored and had a small necrotic area with an angry base on the distal surface. No lymphatic extension was discernible. The foot was warm, the end of the first toe only being cold. The entire toe and dorsum of the foot were acutely tender. There was no pulsation in the dorsalis pedis artery and only a faint pulsation in the posterior tibial. In hopes of saving the foot, immediate steps were taken to control the diabetic condition. For this purpose he was transferred to the Institute on the evening of January 22.

On admission to the Institute the plasma sugar was .234 per cent, with heavy plasma acetone and carbon dioxide combining power of 42.4 volumes per cent. The urine gave a heavy reaction for sugar and acetone. The temperature was 101.8 degrees F. with a pulse of 110 and respirations 32. A blood count showed white cells 13,000, 87 per cent of which were polymorphonuclears.

On account of the inflammatory œdema of the affected foot and also the moisture at the bases of the lungs, a salt free, liquid diet, composed entirely of carbohydrates, was allowed. Insulin was given in large doses at once. Additional carbohydrate was added with frequent administration of insulin and small doses of bicarbonate of soda (see chart) to combat the acidosis. Tincture of digitalis was given in moderately large doses, fluids were forced and magnesium sulphate, 1 ounce, given. Hot aluminum acetate compresses were applied locally. January 24, the distal part of the second toe as well as the first became involved with extension of discoloration to the dorsum of the foot. Œdema was marked as was the acute tenderness with lymphatic extension and hyperæmia, the former rapidly extending proximally along the anterior aspect of the leg to within 3 inches of the knee. Patient was toxic, temperature was 100, pulse 100. Immediate operation was advised. Patient was transferred to All Souls Hospital, and the leg prepared above the knee with iodine and alcohol. Nitrous oxide with a small amount of ether was used. Guillotine operation was performed at the junction of the middle and lower thirds of the femur. Tissues were allowed to fall loosely over the end of the bone; two chromic sutures were taken loosely in the muscles; no skin sutures were made. Twenty minutes after operation patient suffered a severe surgical shock necessitating emergency measures. Healing progressed very satisfactorily. The skin edges rapidly healed by secondary intention, after a strap of adhesive was passed over the end of the stump drawing the edges together. In six weeks healing was complete with a good pad over the bone.

The accompanying chart (No. 3,204) shows step by step the medical preparation for operation. Throughout we tried to keep the blood sugar normal. Importance is attached to the benefit of a low calory diet relatively high in carbohydrate (especially in the obese) as a factor in promoting healing and preventing ketosis. This will be referred to again. A moderately large dose of insulin was given immediately before operation. Glucose was given intravenously in this case while the surgeon was "finishing up." Fluid was taken freely by mouth within half an hour after leaving operating room. At no time was there nausea or aversion to the food.

With the eradication of infection and absorption of toxins, resumption of normal temperature and loss of weight, with the diabetes under control, and with the exercise permitted during the last few weeks of convalescence, the gain in tolerance was marked as shown by the fall in the insulin requirement despite an increase in diet.

Numbness, coldness, cramps in the legs as well as vesicle formation on the extremities should all be warnings. Control of the diabetes and also meticulous hygienic care as suggested by Joslin (6) should be exercised. Clinical experience as well as experimental proof (8) teaches that infection is more rampant in the presence of hyperglycæmia. Sclerosis with partial occlusion diminishing the supply of blood to the parts is the direct cause of the local symptoms. The first necrosis may be a dry one, but secondary infection and consequent liquefaction of tissue leads to an acute, rapidly progressive inflammatory process with swelling, lymphatic extension, and acute tenderness as well as toxæmia. Venous stasis in the presence of dead tissue affords an excellent medium for the reproduction of saprophytic organisms. Sulphuretted hydrogen is evolved as bacterial digestion proceeds (Boyd).

The dry type following occlusion of the vessel and thrombosis proceeds slowly with absence of the acute picture. Secondary infection, with fulminating progress, is the chief danger.

Amputation is indicated if actual tendon or bone involvement exists. The moist type does not tend to demarcate. Delay increases the danger. Vessel change will determine site of operation. The X-ray is no small help in this respect. Partial foot amputations merely court disaster. For one foot which may be saved in this manner several lives may be lost. We probably err occasionally on the side of conservatism but, on the

whole, amputations below the knee have been favored with good results only when an apparently normal popliteal circulation is present, when there is no extensive lymphangitis, and when the patient is relatively young. In the elderly, apparently healthy tissue is deceiving, pulsating vessels may easily be occluded, and a second operation may be fraught with great danger. Removal above the knee is the operation of choice in such cases, and the choice should be that of the surgeon, not of the patient.

Mention may be made of the possibility of better results with the bilateral hooded flap operation of Stephen Smith (11). This method provides an excellent blood supply to both flaps, and if properly executed will leave a scar well drawn up posterior to the bone surface and will give a freely movable stump. The anterior and posterior flap method has not proved entirely satisfactory. This we attribute to the naturally poor circulation in the anterior flap made worse by the pulling of the posterior flap on the suture line with resulting pressure necrosis of the former. Hanford combats this by placing a soft splint posteriorly and by using traction with adhesive on the posterior flap to prevent tension on the suture line when the patient slides down in bed during early convalescence.

Well prepared poor risk. A somewhat undernourished white female, age 51, weighing 123¼ pounds, 5 feet 1½ inches in height, complaining of progressive dimness of vision (bilateral), pains in the right shoulder and interscapular region, morning headaches, fatigue, and constipation, was admitted to the Institute May 9, 1925. Family history was negative. Patient had had scarlet fever, whooping cough, measles, and mumps in childhood; at 32 she had all teeth removed on account of pyorrhœa alveolaris; at 33 a panhysterectomy was performed following the diagnosis of multiple uterine fibromata. She received antiluetic treatment about the same time. The present illness was discovered in 1912 when she consulted a physician following a loss of weight with progressive weakness. Glycosuria was found. A low carbohydrate diet was instituted and maintained until 1914, when the total calories were also reduced. The latter restriction was maintained for only a short time. Irregularities of diet were frequent owing to circumstances. Strength was never regained. During the year of 1924 she first suffered with pains in the right shoulder and interscapular region. During the same year the dimness of vision was progressive.

Physical examination on admission revealed pallor, undernutrition, diabetic and so-called albuminuric retinitis (bilateral), absence of teeth, tonsils slightly enlarged with no apparent infection, heart enlarged to the left (9 centimeters from midsternal line in fifth space), soft systolic murmur at apex not referred, aortic second accentuated, blood pressure, systolic 240, diastolic 115, pulsus alternans present, abdominal wall flaccid, lower left rectus operative scar, slight tenderness over gall-bladder area, knee jerks sluggish, slight puffiness about the ankles.

Laboratory tests revealed a plasma sugar of .209 per cent, urea of .088 per cent, plasma sodium chloride .614 per cent, Wassermann negative. The urine gave a moderately heavy reaction for sugar with traces of acetone. Albumin was present to the extent of 2 to 4 grams per liter. The specific gravity varied between 1008 and 1018 and the chloride output was 5.0 grams. There were many hyaline and occasional granular casts. Blood count showed red blood cells, 2,200,000; hæmoglobin, 49 per cent; leucocytes, 10,300, polymorphonuclears, 72 per cent; small lymphocytes, 25 per cent; large lymphocytes, 2 per cent; transitionals, 1 per cent. Size, shape, and staining of the cells were normal.

The diagnoses were: diabetes mellitus with retinal changes, chronic interstitial nephritis with urea retention and arterial hypertension, secondary anæmia, chronic myocarditis, and chronic cholecystitis.

The preliminary observation diet was 60 grams protein, 60 grams carbohydrate, and 1,100 calories, strictly salt-free. Insulin was begun May 22, 1925. Both diet and insulin were rapidly increased. Continuous observation with strict treatment in the Institute has been maintained in this case until the present time. By the latter part of June, 1925, the blood pressure had responded to levels varying from 120 to 126 systolic and 70 to 80 diastolic. This feature remained satisfactory until the first part of November when, with frequent attacks of gall-bladder colic and other signs of an active cholecystitis, it increased to 180 to 200 systolic and 80 to 100 diastolic. With increasing frequency of attacks of abdominal pain, progressive weakness and apparent rapid approach of invalidism, operation was decided upon. Gas and oxygen were used with a minimum of ether for relaxation during the actual excision of the gall bladder.

There were dense adhesions occluding the foramen of Winslow and surrounding the gall bladder. Appendectomy was also performed.

Pathological examination revealed a thickened wall of gall bladder with lymphocytic infiltration of mucosa and muscular coat. There was considerable scar tissue. Examination of the appendix showed atrophic chronic inflammatory changes.

The preparation and management, as shown in chart 2,586, consisted in preliminary high carbohydrate, low fat, low calory diet, insulin and carbohydrate at midnight, usual morning insulin, a small dose also immediately before operation, intravenous glucose immediately after operation, liquids by mouth 1 hour and 15 minutes after operation, one small dose of bicarbonate of soda, liquid diet in six feedings for 2 days, insulin following nourishment to prevent possibility of hypoglycæmia, five feedings (soft) for 2 days and four for 2 days, after which regular diet was resumed. Healing of wound was normal in rapidity. A "doughy," œdematous, migratory area about the incision, changing location with the position of the patient during the first few days, made us suspect secondary infection.

Accompanying the recovery, a lowering of the insulin requirement, a decrease in the nitrogen retention and albuminuria, and resumption of normal blood pressure rapidly ensued. Improvement in vision was slow but decided. The blood count has assumed normal values after 6 months. At the present time (June, 1926) she walks several miles daily besides doing light work without discomfort.

Well prepared good risk. Case 2,695, a white female, age 47, weighing 125 pounds, and 5 feet 3 inches in height, was admitted November 18, 1925. Knowledge of an existing diabetes dated back 2 months, when glycosuria was discovered following drainage of the right frontal sinus. The chief symptoms were rapid loss of weight (60 pounds in 3 months) and severe frontal headaches. Past history was negative with exception of a series of operations for sinusitis. The family history was irrelevant.

Physical examination revealed tenderness over both maxillary and both frontal sinuses with exquisite tenderness over the right supra-orbital notch; accentuation of aortic second sound; blood pressure 180–100.

The accompanying chart No. 2,695 contains the laboratory data, which indicate a mild diabetes which was readily controlled by restriction of carbohydrate and preliminary restriction of total calories. The diet was made salt free owing to the complicating arterial hypertension.

She was readmitted January 18, 1926, complaining of an aching pain over the distal third of the left humerus. This symptom dated back to within a few days after her previous discharge. Examination revealed an indurated area 2 inches long and 1½ inches wide over this area, with acute tenderness at one point. In view of the necessity of beginning insulin at home and increasing the dose to 62 units, the local manifestation shown on physical examination, and X-ray plates, a diagnosis of periosteitis and osteomyelitis of a subacute nature was made. At no time was there any elevation of temperature.

Operation under gas and ether on January 20 confirmed the diagnoses. The periosteum was thickened and granular. The granulations were removed with a curette and an osteotomy sufficient to allow curetting away of the granular material found in the medulla was performed. A culture was grown and staphylococcus albus found.

Pre-operative and postoperative management consisted of 2 days of high carbohydrate, low fat, low calory diet, usual dose of insulin before meal prior to operation, moderate dose immediately before operation, glucose intravenously before leaving operating room, frequent insulin doses and feedings, liquids given 20 minutes after operation was concluded, soft diet allowed evening of same day and regular diet on second postoperative day.

Rapid decrease in the insulin requirement and entire freedom from symptoms rapidly ensued. There was no nausea at any time. Recovery was uneventful.

Realization of the necessary elasticity in details and chronological outline of the program in each individual case is necessary if optimum results are to be obtained.

Co-operation of the surgeon interested in these cases with an internist who has had experience in their management, the choice of anæsthetic and duration of its administration, judgment and dexterity of the surgeon, age of the patient, resistance to infection, vessel wall changes, the nature of the operation, previous intelligent management by the referring physician as well as the severity of the diabetes, are factors which have a direct bearing on the prognosis.

In regard to the pre-operative and postoperative management, it naturally divides itself into emergency conditions, where little time is left for preparation, and those in which time of operation is a matter of choice. In cases of emergency, almost without exception, the surgical condition deserves precedence. There is, however, a balance which must be considered. Foster (4) states that major operations performed while the blood sugar is above .350 per cent and the carbon dioxide combining power of the blood plasma below 35 volumes per cent end fatally. In the event of such chemical findings, we consider the risk less by waiting 2 or 3 hours, during which time radical measures are adopted to increase the carbon dioxide combining power. Large doses of insulin, such as those employed in treatment of coma, with quantities of glucose and moderate doses of bicarbonate of soda, may be given without danger by experienced hands. The danger of hypoglycæmia is minimized in the presence of infection, fever, or toxæmia, or during a general anæsthesia. Increase of the carbon dioxide combining power is much more essential than a normal blood sugar. Following operation the principle of the treatment is the same as in the well prepared diabetic patient.

The thorough preparation of a patient therefore includes the following:

1. Three days prior to operation the carbohydrate content of the diet is increased to at least 100 grams. The fat is kept low. The insulin is increased, if it is found necessary, to keep the plasma sugar normal.

2. The hour of operation should be in the morning, say 9:00 a. m. The most critical period will be passed before night.

3. At 6:00 a. m. the carbohydrate content of the usual breakfast plus 10 grams is given in glucose or orange juice. The usual morning insulin is given at the same time. Fluids are given in liberal quantities until 8:00 a. m.

4. Simple enema at 7:30 a. m.

5. Immediately before going to the operating room a blood specimen is taken for sugar, acetone and plasma bicarbonate determination. Insulin is given at this time, the dose varying from 10 to 20 units. The smaller dose is employed in undernourished subjects while to the robust and well nourished a larger dose is given.

6. Before leaving the operating room 30 or 40 grams of glucose is given intravenously.

7. Upon returning to the ward 20 to 30 units of insulin is administered, consideration being again given to the physical status of the patient in deciding upon the dosage.

8. Two hours later a blood specimen is taken for carbon dioxide combining power, acetone, and sugar estimation. Based on these analyses insulin and carbohydrate are given. Only rarely, when the above program is adhered to, have intravenous glucose or liquids by bowel to be resorted to later. If these measures are necessary it is important that an accurate record be kept of the actual amounts retained. Fluids by mouth are, in all but the very exceptional case, retained within 20 minutes or one-half hour after consciousness is regained.

CASE No. 3,204

Date	Diet					Time		Insulin: Units		Urine			Blood Plasma					Wgt. lbs.	Remarks
	Prot. gm.	Fat gm.	C.H. gm.	NaCl gm.	Total calories	A. M.	P. M.	Total	Distribution	Sugar	Acet.	Alb.	Sugar mg. per 100 c.cm.	NaCl mg. per 100 c.cm.	Urea mg. per 100 c.cm.	Acet. c.cm.	CO_2 Vol. %		
1926 Jan. 22			10 50	0 0			9:00 9:30	50	10 40	h h	h h	tr.	234		37	h	42.4		Tincture digitalis M. 20 q. i. d. Bicarbonate of soda gm. 5. Fluids forced.
Jan. 23	60	Low	20 90	0		3:00 9:00	 12:00 7:30	44	8 12 8 16				168 (7:30 a. m.)			v. f.			Magnesium sulphate oz. 1.
Jan. 24	20 20	Low Low	30 60 20 20 20	0 0		7:45	12:00 2:30 3:00 5:00 7:30	146	12 40 50 8 16 20	h m o	m f vf.	o o o	211 (3:40 p. m.) 250		34	o m			Fluids forced (per os). 12:00 p. m. operation decided upon. 4:30 p. m. transferred to All Souls Hosp. 5:00 p. m. leg amput. 5:30 p. m. glucose 30 gm. intravenously, immediately after operation. Severe postoperative shock. 6:40 caffeine sod. benz. grs. VII. 6:45 p. m. adrenalin M.X. 6:55 M.x.
Jan. 25			10 30 30 30 30			12:00 6:00 8:20	 4:00 8:00	94	4 20 20 20 30	o	o		113 (7:30 a. m.)			o			4:00 a. m. bicarbonate of soda gm. V. 8:20 a. m. bicarbonate of soda gm. V. Glucose, orange juice.
Jan. 26			30 30 30 30 30			2:00 8:00	 12:00 4:00 8:00	112	30 20 12 20 30	o	o		69 (8:00 a. m.)			o			Orange juice, gruel.
Jan. 27	15 12		30 30 30 30 12:00			2:00 8:00	 12:00 6:30	88	20 20 12 24 12	f o o	o o o		199 (8:45 a. m.)			o			Grapefruit, orange, gruel, milk.
Jan. 28	36	Low	150	0				102	5 doses	f.o	o o o		191 (8:00 a. m.)			o			Regular diet.
Jan. 29	45		110	0				98	4 doses										
Jan. 30	45		110	0				88	4 doses	m.o.o.	o o o		226			o			
Jan. 31	45		110	0				96	4 doses										
Feb. 1	45	Low	110	0	1000			106	4 doses										
Feb. 2	45	Low	110	0				106	4 doses									149¾	
Feb. 3	60	40	100	0	1000			96	4 doses	o	o		115	573	30	o	53.7		Transferred to Institute.
Feb. 6	60	40	100	0	1000			66	3 doses	o o o	o o o		160			o			
Feb. 17	60	48.8	80	0	1000			70	3 doses				130						
March 2	60		80	0	1100			54	3 doses	o o o	o o o		91						
March 9	90		90		1100			38					91						
March 21	100	44.4	100	0	1200			16	2 doses	o o o	o o o		97					148½	
March 22	100	44.4	100	0	1200			16		o o o	o o o								
March 23	100	44.4	100	0	1200			16		o o o	o o o								
March 24	100	44.4	100	0	1200			16		o o o	o o o	o	93						

CASE No. 2,586

Date	Diet				Time		Insulin: Units		Urine			Blood Plasma					Wgt. Lbs.	Blood Pressure		Remarks
	Prot. gm.	C. H. gm.	NaCl gm.	Total calories	A. M.	P. M.	Total	Distribution	Sugar	Acet.	Alb.	Sugar mg. per 100 c.cm.	NaCl mg. per 100 c.cm.	Urea mg. per 100 c.cm.	Acet.	CO_2 Vol. %		A. M.	P. M.	
1925 May 9	60	50	0	1100					m. m.	tr. tr.	4.0	209	614	88			123	240–115	220–110	Admitted.
June 21	50	80	0	1500			30	18, 12	0 0	0 0	0.75	133	589	66			118	150–75	150–80	
Sept. 23	35	100	0	1500			30	18, 12	0 0	0 0	0.4	123	577	48			116	140–80	150–80	
Nov. 7	60	60	0	1600			24	16, 8	0 0	0 0	1.4	108		56					180–100	
Nov. 10	50	120	0	900			36	20, 16												
Nov. 11	50	120 20 midnight	0	900			36 18 midnight	20, 16				128 (7:30 a. m.)		60	0	58.0				
Nov. 12		50 40 intrav. 100 by mouth 30 30			6:00 9:00 10:30 11:45 12:00	1:00 7:00	144	20 10 30 40 24 20	m.	0	mod.	300 (12:30 p. m.)		48	0	51:6				Transferred to All Souls Hosp. Liberal fluids up to 8:00 a. m. Operation 9:00 a. m. Soda bicarbonate gm. 5 at 7:00 p. m. 6:30 p. m. vomited.
Nov. 13		40 40 40 40 20			6:00 8:00 12:00	12:00 4:00	96	30 30 12 12 12	f. f.f.	f. f.f.	tr.	121 (7:30 a. m.)			0					
Nov. 14	30	130	0	Low			72	12 after each of six feedings												
Nov. 15	30	130	0	Low			40	8 after each of five feedings	0 00	0 00	tr.									
Nov. 16	30	130	0	Low			40	8 after each of five feedings	0 00	0 00	tr.	140 (a. m.)								
Nov. 20	30	100	0	1600			24	6 before each of four feedings	0 00	0 00	tr.	128 (a. m.)								
Dec. 23	40	100	0	1800	8:00	12:00 5:00	28	10 10 8	0 00	0 00	0	146 (a. m.)		46	0			148–70		
1926 April 26	40	100		2400	8:00	5:00	22	12 10			tr.	125 (a. m.)					121¼			

CASE No. 2,695

Date	Diet				Time		Insulin: Units		Urine			Blood Plasma					Wgt. lbs.	Blood Pressure		Remarks
	Prot. gm.	C.H. gm.	NaCl gm.	Total cal.	A. M.	P. M.	Total	Distribution	Sugar	Acet.	Alb.	Sugar mg. per 100 c.cm.	NaCl mg. per 100 c.cm.	Urea mg. per 100 c.cm.	Acet.	CO_2 Vol. %		A. M.	P. M.	
1925 Nov. 13									Heavy	hy.	o	242		28	Faint					
Nov. 18	70	50	o	1200			—	—	o m.m.	h.m.		166					125	180–100		
Nov. 24	80	80	o	1200			—	—	o o o	o o o		122			o		123	140–80	130–80	
Dec. 2																				Discharged.
1926 Jan. 18	70	100	o	1800			62	32–20–10	o vf. o	f.f.		133			o					Readmitted.
Jan. 19	70	100	o	Low			62	32–20–10	o											
Jan. 20	30	40 35 intrav. 60 30		Very low	8:00	12:30 1:15 1:30 6:00 9:15	110	32 14 24 30 10	o	o		086 (7:30 a. m.)			o	77.7				10:00 a. m. transferred to All Souls Hosp. 12:45 p. m. to operating room. 1:30 p. m. morphia 1/6. 1:40 p. m. fluids ad lib.
Jan. 21	20 20	20 30 40 40 20	o o	Low Low	2:00 7:30 12:00	12:30 5:30	72	8 16 20 20 8	Faint	tr.		071 (4:30 p. m.)								No symptoms of hypoglycæmia.
Jan. 22	60	120	o	Low																
Jan. 23	60	100	o	1200			38	16–14–8	o o	m. o		106			o			136–78	134–76	Transferred to Institute.
Jan. 24	60	100	o	1400			28	12–12–4	tr. o o	o o										
Jan. 31	60	100	o	1600			12	6–6	o o o	o o		116			o		118			
Feb. 2	60	100	o	1600			12	6–6	o o o	o o										Packing removed.
Feb. 3	60	100	o	1600			12	6–6	o o o	o o							119			Discharged.

Intrav: intravenously, hy: heavy, m: moderate, tr: trace, vf: very faint

9. The diet should be liquid (orange juice, grapefruit juice, grape juice, gruel, ginger ale, glucose) and soft, until the temperature is normal and other manifestations of toxæmia disappear. The total calories should not exceed a maintenance diet during the period of active healing. High diets plus insulin have not increased the power of healing (Allen). Instances in which this seems to have been true suggest that the results prior to insulin were not the best obtainable.

SUMMARY

1. A classification of surgical diabetic cases based on the preparation and apparent risk is presented.

2. Special attention is drawn to the advantages of the Stephen Smith lateral flap method of amputation.

3. Diets high in carbohydrate, low in fat and total calories for preparation for operation and restriction of the total calories to at least a maintenance level during the active stage of healing have proved to be the most effective dietetic measures in these cases.

4. Insulin given immediately before operation and glucose intravenously immediately after are considered important factors in preventing ketosis and vomiting.

5. When the outlined program is followed, fluids can be taken early by mouth.

6. Every effort to keep the blood sugar normal throughout was made in each case.

NOTE.—We are indebted to the Physiatric Institute and All Souls Hospital for the use of records pertaining to cases cited.

BIBLIOGRAPHY

1. ADAMS, S. F., and WILDER, R. M. Surgical risk of diabetic patient. Surg. Clin. N. America. 1924, iv, 587–593.
2. BAUMAN, L. Diabetes in surgical patients with special reference to insulin. Surg., Gynec. & Obst., 1925, xli, 272–283.
3. FITZ, R. Surgical anesthesia in relation to diabetes mellitus. Am. J. Surg., 1922, xxxvi, 46–48.
4. FOSTER, N. B. Surgical aspects of diabetes. J. Am. M. Ass., 1925, lxxxiv, 572–576.
5. JONES, D. F., MCKITTRICK, L. S., and ROOT, H. F. Abdominal surgery in diabetes. J. Am. M. Ass., 1925, lxxxv, 809–812.
6. JOSLIN, E. P. A diabetic manual. 3d ed. Philadelphia: Lea and Febiger, 1924, pp. 122–125.
7. JUDD, E. S., WILDER, R. M., and ADAMS, S. F. Surgery in the presence of diabetes. J. Am. M. Ass., 1926, lxxxvi, 1107–1110.
8. LEWIS, M. R. Importance of dextrose in medium of tissue culture. J. Exper. Med., 1922, xxxv, 317.
9. MASON, E. H. Diabetic as a surgical risk. Canadian M. Ass. J., 1925, xv, 601–605.
10. PETTY, O. H., and LEFEVRE, W. M. Insulin in diabetics requiring surgery. Med. Clin. N. America., 1924, viii, 919–930.
11. SMITH, S. Bilateral hooded flap. Bickham's Surgery. Saunders: 1908, p. 425.
12. WEEDEN, W. M. Mortality of surgical complications in diabetes. J. Am. M. Ass., 1924, lxxxii, 1165–1166.
13. WILDER, R. M., and ADAMS, S. F. Wisconsin M. J., 1924, xxii, 557–561.

A MODIFIED TECHNIQUE FOR DIFFICULT INGUINAL HERNIAS[1]

By CHARLES E. FARR, M.D., F.A.C.S., New York

THE Bassini operation for inguinal hernia has proved eminently satisfactory in a very large majority of cases. In children it is ideal and offers practically 100 per cent of cures. In adults with indirect hernia and good musculature, the Bassini operation gives well over 90 per cent of permanent cures. This is as much as should be expected of any operation. In cases that are selected with reasonable care and in which operation is done with reasonable skill, there will be very few failures.

In direct hernia and in some indirect hernias with large rings and poor musculature, the outlook is bad for cure by any simple operation. The elaborate technique of fascia suture has improved greatly the statistics of cure. This operation, however, requires exceptional technical skill and its results must depend upon perfect technique and clean wounds. For this type of hernia a much simpler procedure has proved successful in a moderate number of cases. The operation is based upon the fact that if sound healing takes place between the conjoined tendon and Poupart's ligament without tension, the probability of cure is very high. Poupart's ligament can not be approximated to the conjoined tendon. The latter must be brought to the ligament. This can be accomplished in the average case by the use of tension sutures but such sutures are only too apt to cause necrosis, or to break. Non-absorbable sutures have the same inherent weakness.

Many methods have been devised to overcome this defect. The one offered is simple, easily performed, does not destroy any tissue, and seems quite efficacious. It consists of the usual Bassini technique up to and including the placing of the deep sutures and preceded if possible by a separate suture of the transversalis aponeurosis with fine chromic catgut, thus re-enforcing a weak spot at the deep ring. With the usual deep sutures of chromic catgut in place, it is easy to estimate the amount of tension necessary to approximate the conjoined tendon to Poupart's ligament. If the tension seems too great for the tissues or the sutures to bear safely, they are left untied until the next step.

This consists of dissecting the skin and fat away from the rectus sheath and the external oblique aponeurosis. The two are intimately fused at the border of the muscle. An incision is then made from 3 to 4 inches in length vertically about the middle of the belly of the muscle from the symphysis pubis upward, through the aponeurotic layers, exposing the belly of the muscle freely. The deep sutures are then tested again. It will be found that there is a very marked relaxation allowing the conjoined tendon and the edge of the rectus sheath to approximate Poupart's ligament without tension. In some cases the fascial line of the linea semilunaris can be drawn to Poupart's ligament for a distance of 2 inches. The sutures are then tied, the cord transplanted, and the external oblique imbricated if there is sufficient tissue, as there surely will be with this technique. The skin is then closed in the usual fashion.

SUMMARY

This simple procedure is much more easily carried out than most of the plastic modifications of the Bassini operation. It gives no additional weakness to the abdominal wall. It requires no special skill. It results in a firm union of sound tissues. The percentage of good results with this technique should be considerably higher than with the straight Bassini operation. There are methods of using the tissues in and about the rectus muscles which have been employed with a moderate degree of success, notably Bloodgood's transplanting of the rectus muscle, and Downes' flap from the rectus sheath. The former placed the tissues in abnormal position and tension. The latter depended upon too weak a structure. The technique described appears to utilize the value of these two methods without their disadvantages.

[1] Presented at the forty-first meeting of the Society of Clinical Surgery, November 12 and 13, 1925, New York City.

A NEW APPARATUS FOR THE TRANSFUSION OF UNTREATED BLOOD

By JEROME R. HEAD, M.D., Chicago
Instructor in Surgery in the University of Illinois

THE apparatus here to be described is presented in the belief that it is an improvement in the mechanics of blood transfusion and that with it transfusions can be performed more simply, more rapidly, and more safely than with the appliances heretofore in use.

In direct transfusion the donor's artery is used rather than the vein because venous pressure is not sufficient to force the blood across. It has occurred to many that if some force pump could be inserted in the system which would suck the blood from the vein of the donor and force it into that of the recipient, at the same time measuring it, and if this could be done by venepuncture rather than venesection, a system as near the ideal as possible would be attained. Erasmus Darwin, the father of the naturalist, is responsible for the first suggestion of this nature. The apparatus planned by him in 1796 consisted of two lengths of goose quill united by a piece of chicken gut. The blood was to flow from the donor until the gut was distended, and then, by pressure on this receptacle, be forced into the recipient. The suggestion was never given a trial, but the idea has been the basis of many methods since devised and of many in use today.

These latter are too numerous to mention in a report of this nature. I believe that the apparatus here presented is superior to them in the following respects: (1) It is valveless. (2) It keeps the blood more constantly in motion. (3) The danger of the leakage of air is absolutely eliminated.

The apparatus consists of the barrel, *A*, and the piston, *B*. The motion of the piston is governed by the eccentric, *C*, which in turn is operated by the crank, *D*. As the crank is turned the piston is moved up and down in the barrel and is so rotated by the eccentric that on the upstroke the slot, *S*, is opposite the intake port, *I*, and on the down stroke the slot, *T*, is opposite the outlet port, *O*. Thus on the upstroke 1 cubic centimeter of blood is drawn from the donor and on the down stroke is forced into the recipient. The possibility of the entrance of air around the piston is eliminated by sealing the joint between piston and barrel with normal salt solution contained in the cup shaped extension at the top of the barrel. The counter, *8*, records each revolution of the crank and consequently the number of cubic centimeters of blood transfused. The barrel and piston are made of Monell metal, a compound of nickel which has an exceptionally low coefficient of expansion. This eliminates the danger of jamming of the piston as the parts are warmed by the fresh blood.

The actual transfusion is carried out as follows: The donor and recipient lie parallel to each other on tables, carts, or beds of an equal height. These are arranged 2 feet apart and between them is placed an arm board 18 inches in breadth. The left arm of the donor and right arm of the recipient are extended on the board and the antecubital fossæ painted with iodine. The apparatus is then clamped to the arm board in such a position that the tubes will reach the prospective sites of venepuncture. Salt solution is poured into the cup (u). Both tubes are then placed in a small basin containing normal salt solution and the crank turned until air bubbles cease coming from the outflow. The tourniquets are applied and the needle, unattached, inserted into the recipient's vein. As soon as blood flows from it the tourniquet is removed and the outflow tube connected with the needle. With the other tube still immersed in the salt solution the crank is turned slowly so that the operator can be sure that the puncture has been accurate and that there is no leakage. While an assistant slowly turns the crank injecting salt solution into the recipient, the donor's vein is punctured. When blood flows from it, the assistant stops turning the crank, the operator connects the inflow tube with the needle, and, having observed the reading on the counter, proceeds with the transfusion.

The crank is conveniently turned at the rate of approximately 100 revolutions per minute. This produces a flow through the system practically identical with that in the intact arteries. The elasticity of the rubber tubes prevents a complete stasis at any part of the cycle so that in them, as in the arteries, there is a true diastolic flow and pressure. The outflow through the recipient's smaller needle is maintained continuous by the pressure exerted by the slightly distended tube. During the upstroke of the piston there is a uniform contraction of the tube running from the donor, dilatation following as the suction ceases

on the down stroke and the blood flows in to fill it. Under these conditions clotting in the system is practically impossible. It requires but 5 seconds for a unit of blood to flow through the system.

The apparatus was first tried as a pump to draw blood into citrate solution. After it had been demonstrated that it would do this satisfactorily, that straining of the blood showed no clots, and that no undue reactions occurred in patients to whom it was given, it was used to give a direct transfusion.

It has since been so used a great number of times at the Research and Educational Hospital of the University of Illinois, at the Augustana Hospital, Chicago, and at the Mayo Clinic. In my experience with it there have been no reactions in instances in which the bloods of the donor and recipient were carefully cross matched. When grouping alone was used there has occurred, as there will with all methods, an occasional elevation in temperature or chill. Dr. J. DeJ. Pemberton of the Mayo Clinic writes: "The apparatus has been used a great number of times and with complete success."

The experience with the apparatus to date seems sufficient to warrant the assumption that in its translation from the donor to the recipient the blood is not altered in a way that favors reactions or impairs its therapeutic effect. The first and chief requisite of an ideal method of transfusion is consequently fulfilled. In regard to the other requisites the situation is as follows: (2) The volume of blood transferred is accurately recorded by the automatic counter. (3) There is the least possible inconvenience and trauma to the donor and the recipient, both veins being entered by venepuncture. (4) The procedure can be carried out by one man, in any place, at any time, and upon a moment's notice. (5) There is no possibility of air entering with the blood. (6) In case anything goes wrong, no blood is wasted.

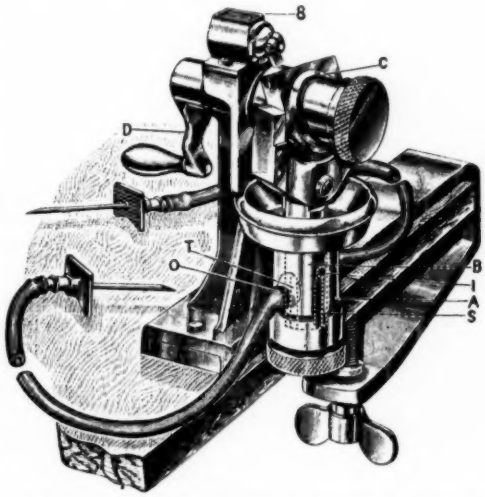


Fig. 1. *a*, Barrel; *b*, piston; *c*, eccentric; *d*, crank; *s*, slot; *i*, intake port; *t*, second slot; *o*, outlet port.

UNTREATED CANCER OF THE BREAST

By ERNEST M. DALAND, M.D., F.A.C.S., Boston

THIS study of untreated cancer of the breast was suggested by Dr. R. B. Greenough, who has been interested of late in the study of end-results being made by the American College of Surgeons. If one is to judge of the efficacy of any type of treatment, it is essential to know the course of events if that agent had not been used. If one is to determine the value of operative or radiation therapy in cancer of the breast, it is necessary that he should study a group of similar cases which have not been subjected to any treatment.

One hundred cases were selected from the records of the Collis P. Huntington Hospital and the House of the Good Samaritan, Boston. There were 79 cases from the former and 21 from the latter. None of these patients, as far as we could learn, had received any treatment for the cancer, either operation, radium, or X-ray. There were 98 women and 2 men in the series.

All data collected go back to the date of observation of the tumor and not to the time of examination. The histories of these patients are by no means complete. The House of the Good Samaritan is a hospital which cares for patients in the terminal stages of the disease. It is difficult to secure adequate data from such patients as to the exact time of onset or the date on which they were first examined. Similarly, it is difficult to tell in what portion of the breast the cancer originated or the early course of the disease.

At the Collis P. Huntington Hospital patients are seen in all stages of the disease. When the hospital was first opened a certain number of patients were admitted for chronic care and stayed in the hospital until death. At the present time large numbers of patients come early enough to be referred for operation elsewhere. Patients are also seen in the late stages but are not admitted to the hospital for chronic care. Data on many cases must be secured by social workers or obtained from city clerks, so that we do not know what happens during the late stages of the disease.

We have found no record of a case in which a cancer of the breast underwent spontaneous regression.

Trauma. The part played by trauma in the causation of cancer of the breast is still undecided, but it is generally believed that it plays a minor rôle. Roepke (8), in 800 cases, found a history of trauma in 2.5 per cent. Williams (13) found ten times as many or 25 per cent in 137 cases. In this series there were 14 with a definite history of trauma.

Operability. We have definite statements in the records of 23 patients that operation was advised, that is, the cancer was recognized early enough to warrant an attempt at radical cure. In every case operation was refused. There were 3 others in whom the general condition of the patient did not warrant operation. Twenty-three (23 per cent) were inoperable when they were first examined. In a group of 176 cases entering the wards of the Massachusetts General Hospital for operation, after the elimination of many in the Out Patient Department, studies by C. C. Simmons and the writer (10) revealed 22 per cent inoperable for radical operations. Primrose (7) reports 32 per cent inoperable when first seen by a surgeon. Deaver's (1) figures are 25 per cent.

Duration of life from onset of disease. The average duration of life from the time of the first symptom to death was 40.5 months. It is interesting to note that in those patients in whom the cancer was detected early and in whom operation was advised the average duration of life was 42.8 months. Those in whom the condition was inoperable at the first examination lived 29 months. The mean duration of the disease in the 100 cases was 30 months, that is, 50 patients were dead and 50 alive at the end of that time.

If we plot the deaths by years (Fig. 1), each dot representing a death, it is interesting to note that the deaths begin as early as 3 months and occur rather rapidly. Twenty-one per cent die the first year, 20 per cent in the second and 19 per cent in the third, so that there are 40 per cent alive with cancer at the end of 3 years. Ten per cent die in the next year, and 8 in the next, leaving 22 per cent who live 5 years without any treatment whatsoever. In the sixth year another 8 per cent die and 5 per cent in the following year. At the end of 10 years 5 patients (5 per cent) were still alive. These 5 died at the end of 10¼, 10¼, 11⅔, 13, and 13 years respectively.

It must be borne in mind again that these figures represent the duration of the disease from the date of onset. Therefore this series cannot be compared with operative results unless the latter are so reckoned.

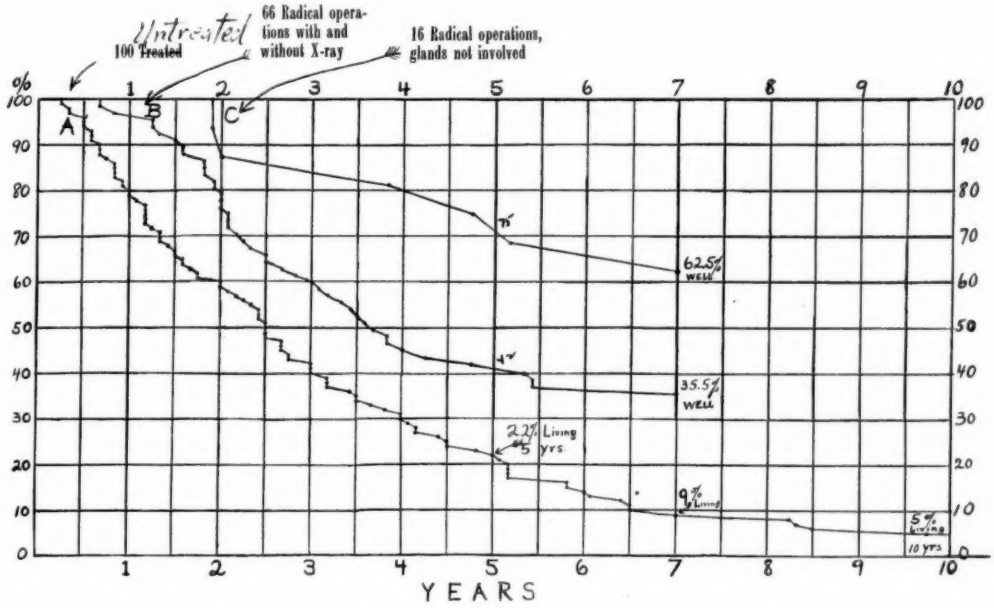


Fig. 1. Duration of life from onset.

One case of interest has been omitted because the patient is still alive. She gives a history of a tumor of the breast, probably cancer, of 35.5 years' duration. Of course we may say that this was not cancer and possibly it was not. However, she was examined in 1914 by Dr. Greenough, who noted that it was inoperable and that it was probably scirrhous in type. The entire breast had been destroyed at that time. The patient is now 80 years old.

Comparison with a group treated by operation. In Figure 1 we have plotted a second curve (B) of the duration of life of a group of 66 patients treated by radical operation. In some of these the glands were involved and in some not involved. Some, but not all, were treated by X-ray following operation. These data were collected by Dr. Greenough and presented in a paper read at the meeting of the American Radium Society at Dallas, Texas, in April, 1926. There was one operative death, occurring 8 months after the onset of the disease. During this first 8 months, curve A shows that 9 untreated patients had died. At the end of 3 years there were 60 per cent, at 5 years 42 per cent, and at 7 years 35.5 per cent alive without disease.

A third curve (Fig. 1) shows the duration of life in a selected group of 16 cases, without involvement of the axillary glands. There was one operative fatality in this series. It is noteworthy that the duration of life in this case, the first death, was 23 months from the onset. After 3 years 88 per cent were well, 75 per cent at the end of 5 years and 62.5 per cent well at the end of the 7-year period.

Age at onset and length of life. The average age at onset was 57.5 years. The youngest patient was 31 and the oldest 87. This average is very high. Possibly the fact that they considered themselves too old or infirm was a factor in their refusing operation. In 148 cases entering the Massachusetts General Hospital (10) for cancer of the breast operations the average onset age was 50.3 years. At the German Hospital in Philadelphia (2) the average was 49.6 years. In a large series compiled from the figures of fifteen surgeons (2) 50.1 was the average, while Primrose (6) gives 49.2 years fo his cases. All these average about 50 years.

Our average length of life was 40.5 months. Figures in the literature vary from 27 months, given by Sprengel (12) as the duration of life for untreated cancer, to 48 months, quoted by Paget (5). Odekop's (4) average was 29 and Sibley's (9) 34 months. The patients in our series had cancer every day of the 40.5 months they lived. That

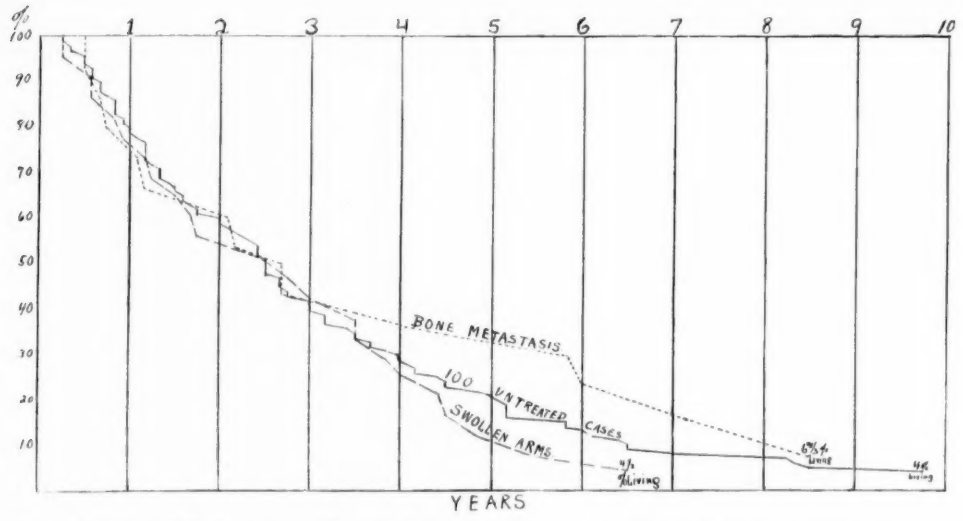


Fig. 2. Duration of life from onset. Untreated 100 cases ————; bone metastases, 15 cases - - - - - - - -; swollen arms, 22 cases — — — — —.

fact must be remembered in comparing the length of life and the comfort of these patients with the groups operated on.

The largest number of cases in any 5-year period (Table 1) was between 45 and 49—the period of the menopause. However, the majority of cases were pretty evenly spread over the years 45 to 74. The youngest patient lived but 25 months as was to be expected, as cancer of the breast is usually very malignant in a young woman. The next two lived respectively 17 and 70 months. Those who contracted the disease just before the menopause lived longer than the average of the series. The shortest time for a large group was seen in the 55–59 year group and the longest in those 60–64. The two aged women, of course, had a very short life expectancy and died early.

Delay before medical consultation. The average delay in 76 cases on which we have data was 18.3 months. The mean delay was between 9 and 10 months. In 176 cases studied at the Massachusetts General Hospital (10) the average delay was 8.2 months.

Effects of previous pregnancy. There was no appreciable difference in the duration of life in those who had previously been pregnant and those who had not. Fifty-five of the former group lived 38.5 months and 28 of the latter group averaged 40.8 months.

Previous disease of the breast. Fourteen patients gave a history of previous pathology in the breast. These conditions were as follows: abscess 3, defective nipple 2, caked breast 5, sore breasts 3, and cysts 1.

Lung and liver metastases. As pointed out before, we are not in a position to determine accurately the late complication in many of these patients. We do have record of lung or pleural metastasis in 18 cases. It is generally stated that the percentage is about 50. Our 18 cases lived only 27.7 months on an average. There were 11 known cases of liver metastasis.

Swollen arms. We have record that 22 patients developed swollen arms during the course of the disease. Usually this was accompanied by glandular metastasis, either axillary or supraclavicular. The significance of these cases is important. We are accustomed to associate many of the swollen arms with operative interference with the lymphatics. Deaver and MacFarland (2) state that 10 per cent of advanced cases of cancer of the breast develop a brawny arm on the affected side, but that it is more common in the recurrent cases. We have not seen other figures quoted. We have no data on the proportion of patients operated on who develop swollen arms, but our impression is that it is no greater than 22 per cent. In other words, a patient stands a 1 in 5 chance of getting a brawny arm even though she does not submit to operation.

The length of life of this group is slightly shorter than that of the whole series, although

TABLE I.—AGE AT ONSET AND LENGTH OF LIFE

Years	Cases	Average length of life Months
30–34	1	25
35–39	2	43.5
40–44	9	54.4
45–49	19	32.6
50–54	10	36.1
55–59	14	27.3
60–64	15	58.4
65–69	12	37.3
70–74	11	45.3
75–79	5	32.6
80–84	1	8
85–89	1	16

TABLE II.—DELAY BEFORE MEDICAL CONSULTATION (76 CASES)

Months	Cases	Months	Cases
No delay	17	18 to 24	10
1 to 3	7	24 to 36	3
3 to 6	11	36 to 48	7
6 to 9	4	48 to 60	3
9 to 12	10	60 to 84	1
12 to 18	2	120	1

TABLE III.—NO DELAY TO MEDICAL CONSULTATION; 17 CASES WITH IMMEDIATE CONSULTATION

Advice given	Cases
Operation advised (and refused)	10
Physical condition too poor for operation	1
No treatment	1
Inoperable	1
"Blood medicine" given	2
Ointment	1
Unknown	1
Average duration of life (17 cases)	29.6 months
Average duration of life (entire series)	40.5 months

the two curves are practically identical for the first 4 years (Fig. 2). The last patient died at the end of 13 years.

Bone metastasis. We have thought of bone metastasis as a late complication in this type of case. Our records show that the patients who developed metastasis in the bone lived essentially no longer than the others (Fig 2), that is, 44 months. The bones involved were those commonly mentioned as the site of metastases, that is, spine, skull, ribs, clavicle, femur, and humerus. There were 3 spontaneous fractures. In 2 or 3 cases the diagnosis of spinal metastasis was made clinically without proof by X-ray or autopsy, but in the others the diagnosis was checked up by one of the latter.

No involvement of the bones below the knee or elbow was noted. Such metastases are very rare, although we have seen one metastasis in the tibia in a woman not included in this series.

TABLE IV.—SWOLLEN ARMS—22 CASES—(22 PER CENT)

	Cases
Swollen arms and lung metastasis	5
Swollen arms and bone metastasis	1
Swollen arms with axillary metastasis	19
Swollen arms without axillary metastasis	1
Unknown	2
Swollen arms with supraclavicular metastasis	14
Swollen arms without supraclavicular metastasis	2
Unknown	6
Average duration of life	36 months
Average duration of life (entire series)	40.5 months

TABLE V.—BONE METASTASIS—15 CASES (15 PER CENT)

	Cases
Single bony metastasis	12
Multiple bony metastasis	3
Bones involved	
Spine	8
Rib	3
Femur (2 spontaneous fractures)	3
Clavicle	3
Humerus (spontaneous fracture)	1
Skull	1
Bone and glandular metastasis	10
Bone and lung metastasis	2
Average duration of life in 15 cases	44 months
Average duration of life in whole series	40.5 months

Pathological examination. Eleven cases came to autopsy. The slides were available for study in 10 of these. A biopsy was done in 1 other case. It was interesting to examine these slides from the standpoint of varying degrees of malignancy. With the assistance of Dr. Greenough, who has recently gone into the subject extensively (3), the cases were graded according to their malignancy. There were none that could be placed in Group 1, the lowest grade of malignancy. Six were placed in Group II and four in Group III. The other case was one which clinically was cancer and is recorded as such at the Harvard Medical School. However, the slides which were available for our study showed a tumor which did not appear to us to be typical of cancer. This woman lived 8 years and possibly the case should be excluded from this series.

The study of the degree of malignancy was based upon the amount of glandular differentiation, the number of metastases, hyperchromatism, hyalinization, the size and variation in the size of the cells and the amount of secretion present in the tumor cells. Of course, we know that all patients with cancer of the breast, if untreated,

die eventually, whatever the degree of malignancy. However, we were unable to demonstrate any longer life in the cases of lower malignancy than of higher. The location of a tumor is of more importance in determining the length of life than the degree of malignancy, so that we would not expect the duration of life and the degree of malignancy to check.

SUMMARY

1. This study deals with 100 cases of cancer of the breast, untreated by operation, X-ray, or radium.

2. Duration of life is computed from the time of the first symptom noticed by the patient. The average duration was 40.5 months, the mean duration 30 months.

3. The longest duration was found between the ages of 60 and 64, the shortest between 55 and 59, except for one patient who was 33 years of age.

4. Length of life in untreated cases is compared with the length of life in two operative series.

5. In the untreated series, 40 per cent were alive at the end of 3 years, 22 per cent after 5 years, 9 per cent after 7 years, and 5 per cent at the end of 10 years. The last patients died 13 years after their first symptom.

6. No definite relationship could be observed between previous pregnancies or diseases of the breast and the cancer.

7. Lung or pleural metastasis was observed in 18 cases; involvement of the liver in 11 cases.

8. Twenty-two per cent had swollen arms. These patients did not live quite as long as the average of the series.

9. Fifteen per cent had bone metastases. They lived slightly longer than the average.

10. A study of the degree of malignancy, as made by microscopic study, failed to show any relationship between the length of life and the degree of malignancy.

CONCLUSIONS

In studying the end-results of cases of cancer of the breast treated by operation or by other means, it must be remembered that many of the patients would have lived many years without such treatment.

To compare treated and untreated cases, both series must be studied in the same way, from the date of onset of the disease and not from the date of examination.

The one factor which makes such a comparison impossible or unfair is that the patients in the one series are alive and well, while in the other they always have cancer.

BIBLIOGRAPHY

1. DEAVER. Cited by Ewing.
2. DEAVER AND MCFARLAND. The Breast, 1917, p. 516.
3. GREENOUGH, R. B. Varying degrees of malignancy in cancer of the breast. J. Cancer Research, 1925, ix, 453–463.
4. ODEKOP. Arch. f. Chir., xxiv. Cited by Ewing.
5. PAGET. Lancet, 1889, i, 571. Cited by Ewing.
6. PRIMROSE. Am. J. M. Sc., 1913, cxlv, 100. Cited by Deaver and McFarland.
7. Idem. Cited by Ewing. Neoplastic Diseases, p. 538.
8. ROEPKE. Arch. f. klin. Chir., 1905, lxxviii, 201. Cited by Deaver and McFarland.
9. SIBLEY. Med. Chir. Tr., xlii. Cited by Ewing.
10. SIMMONS C. C. and DALAND E. M. Cancer: Factors entering into the delay in its surgical treatment. Boston M. & S. J., 1900. clxxxiii, 298–303.
11. Idem. Cancer: delay in its surgical treatment. Boston M. & S. J., cxc, 15–18.
12. SPRENGEL. Arch. f. Chir., xxvii. Cited by Ewing.
13. WILLIAMS. Diseases of the Breast. London: 1894. Cited by Deaver and McFarland.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.....Managing Editor
ALLEN B. KANAVEL, M.D.....Associate Editor

WILLIAM J. MAYO, M.D.....Chief of Editorial Staff

FEBRUARY, 1927

THE TREATMENT OF CHRONIC DUODENAL ULCER—MODERATION IN ALL THINGS

THE healing of duodenal ulcer either spontaneously or by simple forms of treatment, and the removal of a large part of a healthy stomach for the cure of the same disease, constitute one of the strangest contrasts in medicine today. No more striking example of the progress in the control of the symptoms and complications of chronic disease can be found than the results of the surgical treatment of benign lesions of the stomach and duodenum. The recognition of the clinical manifestations of duodenal ulcer and the fact that the symptoms could be permanently relieved in a large percentage of cases by an operation simple in principle, namely, gastro-enterostomy, have set a landmark in surgery. The whole structure of the surgical management of lesions of the stomach and duodenum has been built up around the operation of gastro-enterostomy. The miraculous effect of the operation in cases of marked pyloric obstruction is a matter of common knowledge among the profession and the laity. As the public becomes aware that much chronic indigestion is due to ulcer and that such dyspepsia can be relieved by surgical means, an ever-increasing percentage of patients present themselves for medical attention at a time when the disease is in an early stage, and before any degree of obstruction (the complication so spectacularly relieved by operation) has developed.

Surgeons have gradually realized that the surgical treatment of these early cases is not as satisfactory as of the long-standing cases. Not only is it impossible to obtain the spectacular results which follow operation when obstruction, subacute and chronic perforation, and repeated hæmorrhages have occurred, but the possibility of failure to relieve what symptoms are present and the danger of recurrence of ulceration and reactivation of symptoms seem to be greater in cases without such complications. It is because of certain disappointments from gastro-enterostomy in these early stages (a large proportion of which are not a discredit to the operation but to its selection), that surgeons have considered and tried other types of operation.

Up to the present time, the surgical treatment of duodenal ulcer has given rise to three schools of gastro-intestinal surgery. In the first and oldest school the adherents believe that gastro-enterostomy is the basic treatment for chronic duodenal ulcer. The second school was created by the development of the operation of pyloroplasty by American surgeons, particularly Finney, and comparatively recently a third school has been established by surgeons of continental Europe who have so forcibly advocated partial gastrectomy for duodenal ulcer.

Much of the confusion in determining the relative value of these different principles of surgical treatment has been due to the practice of endeavoring to establish a certain type of operation not on its own merits but on the faults of some other operation. The attempt to make some type of operation a routine has often resulted in unfavorable reactions to an operation which has real merit in selected cases; and as a consequence the really essential factor in obtaining good results, namely the selection of the proper procedure for the individual case, is too often overlooked.

Preceding the selecting of the type of operation to be employed, is the even more important question of whether or not any operation is indicated. By far the most important indication for operation in duodenal ulcer is chronicity, and the best results are obtained in long-standing cases, in which there is impaired gastric motility. Operation is also clearly indicated when hæmorrhage, marked obstruction, and chronic or subacute perforation, have developed. The more nearly conditions approximate the foregoing groups the better will be the results. The principle on which surgical treatment is based and on which good results depend is, in all probability, largely mechanical, that is, relief of intragastric tension and all that it implies. However, the influence of any operation on secretion is a useful, although not always an accurate, index to the probable result of operation.

In regard to the ulcer itself there are two general methods of treatment, the direct and the indirect. Of the indirect methods, gastro-enterostomy holds first place for several reasons: first, because of its simplicity; second, because of the high percentage of cases in which it is not only clearly indicated but in which no other operation can be seriously considered; third, because the results of no operation will excel it in certain cases; fourth, because it may be used as a most useful adjunct in cases in which a direct attack on the ulcer is made; and fifth, because of the very important fact that the anastomosis can be disconnected later, if necessary. Posterior gastro-enterostomy should never be forced, particularly if the patient is obese or if a short mesocolon, adhesions from previous operations, and particularly gastrojejunal ulcers, have created conditions unfavorable to good mechanical function. When cases are properly selected and the operation is properly performed, 90 per cent of the patients report satisfactory results. In less than 5 per cent there is a recurrence of ulceration either in the stoma (when the tendency is about 2 per cent), reactivation of the old ulcer, or failure of good drainage. In this group of 5 per cent, in which recurring ulceration or mechanical difficulties develop, a secondary operation can be satisfactorily carried out.

Partial gastrectomy is frequently employed by its advocates as an indirect operation for duodenal ulcer just as is gastro-enterostomy, that is, the ulcer itself is disregarded and the body and pyloric end of the stomach are removed for physiological reasons. Plastic operation for physiological reasons on any organ of the body, particularly of the gastro-intestinal tract, for example, resection of the colon, plastic operations on the ileocæcal valve and so forth have not been followed by the results which theoretically should follow. Not only is partial gastrectomy a more serious operation, but in the event of subsequent trouble, it is difficult to carry out any further surgical treatment, while gastro-enterostomy does not offer any obstacle to any subsequent type of operation. The future status of partial gastrectomy for chronic duodenal ulcer is problematical, but it can hardly be conceived that it will ever be popular since such a high

percentage of patients can be cured by a simple and non-destructive precedure.

Direct operations for duodenal ulcer imply the removal of the ulcer, and are indicated especially for repeated hæmorrhages or recurrence of symptoms. Such operations must include provision for adequate drainage of the stomach as safely as possible and maintenance of the drainage. It is to be expected that innumerable methods would be devised for reconstructing the pyloric end of the stomach following excision of duodenal ulcer. A very useful adjunct in such cases is the fixation of the pyloric end of the stomach to the right of the median line by a suture. This procedure apparently has a very favorable influence in maintaining proper drainage and preventing retention. It also protects the suture line against undue tension while healing is taking place. Following many of these plastic operations at the pyloric end of the stomach it is found advisable to institute gastric lavage for a few days.

There is no royal road to perfect results in the surgical treatment of such a chronic disease as duodenal ulcer. The best results will come from the correct application of the various available procedures.

D. C. Balfour.

CÆCOSTOMY FOR PARALYTIC ILEUS FOLLOWING EXTRA-PERITONEAL OPERATIONS

INTRAPERITONEAL operations may be followed by abdominal distention, more or less transient, which usually responds to the ordinary remedial procedures. It occurs also as the result of mechanical intestinal obstruction or paralytic ileus secondary to intraperitoneal infection; in this form the distention is persistent and resists ordinary methods of relief.

When distention occurs following intraperitoneal operations one is usually alert for the possible causes, and when it is due to mechanical obstruction or peritonitis there has been little hesitancy in the performance of enterostomy or cæcostomy for relief. In many instances these procedures have been life-saving.

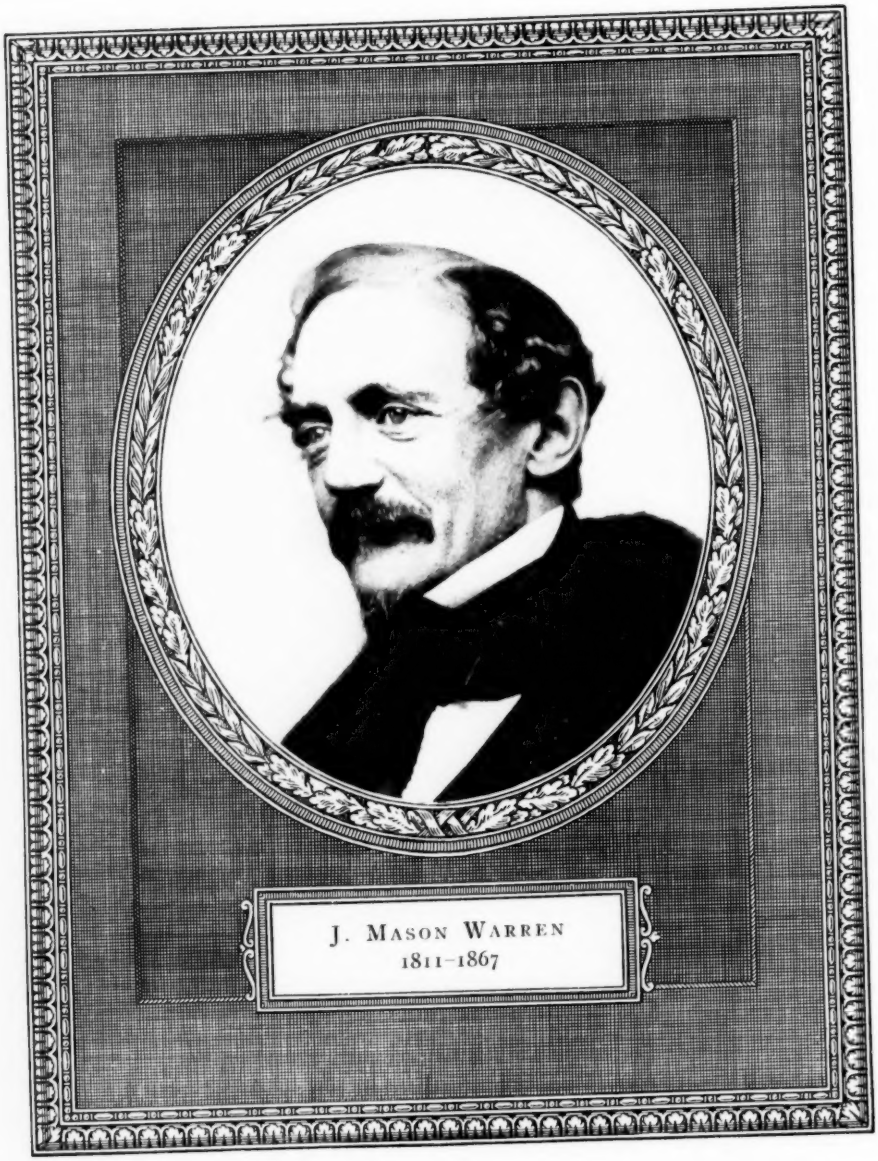
Intractable abdominal distention has been seen in the course of many non-surgical conditions in the absence of intra-abdominal mechanical causes. Likewise it has been seen following operations remote from the peritoneal cavity and the result of paralytic ileus, the cause of which is established with difficulty and uncertainty. Very marked abdominal distention as a result of ileus becomes a serious menace to life when it is resistant to the ordinary methods of relief. Its danger is threefold. The thinning of the intestinal walls, particularly of the colon, allows early extravasation of infective material with resultant peritonitis. Likewise thinning of the intestine favors a break in the continuity of the mucous membrane with necrosis and ulceration leading to perforation. Necropsy has disclosed such instances, with gangrene of portions of the intestinal tract particularly of the terminal ileum and cæcocolon. Kocker has described distention ulcers of the right half of the colon and terminal ileum which caused perforation and death several days after the obstruction had been relieved. The toxæmia of intestinal obstruction rapidly develops and the chemical changes in the blood are those observed by Haden and Orr and others in cases of intestinal stasis, and by Walters in the toxæmia of acute duodenal and gastric fistula. There is rapid depletion of the chlorides and progressive rise in urea occurring with approximately the same rapidity as that following high intestinal or duodenal obstruction, as contrasted with the slowly developing toxæmia of obstruction low

in the intestinal tract. This is easily explained. The normal caliber of the intestine readily allows the passage of gases. However, as distention occurs with inhibition of motility, angulation at the turn of each intestinal coil produces mechanical obstruction at numerous points, and, so far as the effect and toxæmia are concerned, this results in high intestinal obstruction. Deflation at a high or low point in the intestinal tract in the presence of paralytic ileus removes the mechanical angulation of coil after coil until the entire tract is deflated.

Just why true paralytic ileus should occur when the peritoneum has not been opened intentionally or accidentally nor encroached upon in any way is not entirely clear. The toxæmia of renal insufficiency may be a factor for it is most likely to occur in cases in which there has been a variable degree of impairment of renal function pre-operatively. That paralytic ileus may be reflex in origin is suggested by the frequency with which it is encountered in the presence of acute urinary obstruction low in the urinary tract or high in the ureter from stones, and so forth, and in the presence of acute hydronephrosis. It has been noted following any and all types of operation on the urinary tract, particularly following prostatectomy or nephrectomy. Although abdominal distention is usually but temporary and responds to the ordinary methods of treatment, at times, however, particularly following difficult subcapsular nephrectomy, all methods of relief fail. Persisting paralytic ileus becomes rapidly fatal and death may be avoided only by surgical deflation. To be most effective it should not be delayed beyond the establishment of the certainty of failure of non-surgical methods. Surgical deflation may be accomplished by enterostomy or cæcostomy. The latter is preferable inasmuch as the maximal dilatation is usually in the cæcum and ascending colon; the cæcum is readily accessible through a split-muscle incision which allows the introduction of a large catheter or drainage tube, by which the intestinal tract is rapidly deflated and emptied of toxic material. Cæcostomy possesses an additional advantage over ileostomy or jejunostomy in that the intestinal contents from the cæcum do not digest the structure of the abdominal wall. The incision usually heals spontaneously after removal of the tube.

Paralytic ileus does occur following extraperitoneal operations. That the operation has been an extraperitoneal one should not blind one to the serious consequences of the ileus. The success of cæcostomy for the relief of paralytic ileus depends on early deflation after the fruitlessness of non-surgical methods is established. The early institution of cæcostomy has proved a life-saving measure.

VERNE C. HUNT.



J. Mason Warren
1811–1867

MASTER SURGEONS OF AMERICA

JONATHAN MASON WARREN

JONATHAN MASON WARREN was born in Boston, February 5, 1811, at the house, number two Park Street, then occupied by his father, John Collins Warren. His mother was Susan Powell Mason, daughter of Jonathan Mason, a prominent merchant of Boston. He was their fourth child. He was grandson of John Warren, surgeon in the War of the Revolution and first professor of anatomy and surgery at Harvard College, and grand-nephew of General Joseph Warren, elder brother of John Warren and senior member of several generations of medical men in the Warren Family.

In the fall of 1820, Mason Warren entered the Boston Latin School, an ancient and notable institution, one of nearly two hundred pupils under Master Benjamin Apthorp Gould. He graduated in 1825. Then followed two years with Master William Wells, a ripe scholar and an able teacher. In 1827, he was admitted to the sophomore class at Harvard but because of a delicate constitution and continued ill health he was unable to pursue his studies and in March, 1828, with his brother he sailed for Cuba. He was much benefited by the voyage and the climate of the West Indies. Returning in April, he spent the summer with his mother at Castle Hill, Rhode Island, the residence of his grandfather, Governor Collins, near Newport. In 1828, he began his medical studies under the guidance of his father, who, like other prominent members of the profession gave private instruction to medical students, following a system of apprenticeship which dated back to the period when the medical school had not yet been moved from Cambridge to Boston. The old homestead lent itself well to this purpose, affording space in the form of a room with a sanded floor for class work and food as well. Here young Warren and his brother mingled with the medical class and grew up, as it were, in an atmosphere of medicine from early boyhood. In 1830, Mason Warren's name was entered as a pupil in the medical school and in 1832 he graduated, taking his degree on February 25, at the age of 21. The subject of his thesis was: "The Comparative Anatomy of the Digestive Organs in the Four Classes of Vertebral Animals." On March 25, 1832, with Dr. Copley Greene, Mason Warren set sail from Long Wharf on the ship Dover for Charleston, South Carolina, reaching Liverpool in May, this being the regular route of packets. In Charleston he visited Dr. William Symonds, Fellow of Edinburgh and student

with John Collins Warren 30 years before. The year 1832 will long be remembered for the ravages of the Asiatic cholera. Almost the first entry in Dr. Warren's European journal records, "News from Paris gives dreadful accounts of its attacks on that city. One thousand deaths and over per day."

In London, Dr. Warren received kind attentions from his father's old friend Sir Astley Cooper, Liston, Syme, and other leaders of the profession. At Middlesex Hospital, he saw Sir Charles Bell and Mr. Key at Guy's. With letters to Dupuytren, Roux, Civale, and to Baron Huerteloup who had just invented the stonehammer, Dr. Warren arrived in Paris, September 22, 1832. Here he joined the French, German, and American students in the Latin Quarter. He writes to his father as follows: "Greene and I have entered a pension near the school of Medicine. I went yesterday to Hôtel Dieu and attended Dupuytren in his visit. He had forty students with him and performed the operation for cataract on two patients who were lying in their beds; it was done by the light of a candle, all the students crowding and jostling in every direction to see him. He did it with as much sangfroid as if he were only bleeding the men. At La Pitié I followed Louis in his rounds, and saw Velpeau. Tomorrow I go to Civale's hospital, The Necker."

This was a period when Paris seemed to be the center of medical education, as London and Edinburgh had been to a previous generation and as Berlin and Vienna were to the one that succeeded his. Of the eight thousand students frequenting the schools and colleges in the Latin Quarter, more than half were following medicine and surgery. Nowhere else could be found such able teachers, such opportunities for dissection, and such valuable clinical material. The leading professors were men of admitted talent and great experience but they were jealous of their reputations.

Speaking of Dupuytren, Dr. Warren said: "For brutality I do not think his equal can be found. If his orders are not immediately obeyed he makes nothing of striking his patient and abusing him harshly." Dupuytren was the acknowledged leader of all the eminent surgeons of Paris. He was director of Hôtel Dieu, the largest hospital. His countrymen called him "the Napoleon of Surgery" and for many reasons he deserved the title. He had a small though muscular figure, a fine, intelligent face and gray hair. Dr. Warren said of him: "He is by far the best lecturer of his day, delivering his ideas with wonderful clearness and always discussing questions of the greatest practical value."

Next in rank, and almost his equal, was Lisfranc, the head of La Pitié. Dr. Warren writes of him: "His amputations of fingers and toes are very neat and rapid. All his operations are marked by a kind of off-hand way, not premeditated but depending entirely on the state of the disease for the extent to which he carries them. Lisfranc is a great rough man, 6 feet tall with a pleasant face and a voice like thunder. To his patients he is a perfect tyrant. To strangers, however,

he is said to be the most polite of the French physicians." Dr. Warren decided to follow Lisfranc rather than Velpeau as a vast deal of practical knowledge was to be gained from his lectures.

At the Hospital La Charité and later, succeeding Dupuytren at Hôtel Dieu, was Roux. He was spoken of as almost the only surgeon of note in Paris to break in upon the routine of irritating dressings. Roux visited England and had seen the good effects of simpler treatment adopted in the London hospitals.

Mentioning Civale, Dr. Warren said: "The operations he daily performs are of great dexterity and success. To him belongs the honor of first practising lithotrity on the living body. Civale is rather below the average size, stout, muscular, and well proportioned."

Regarding Larry, surgeon-in-chief of Napoleon's Army (at that time about 70 years of age) he writes: "I made a very pleasant and instructive visit a few days since to the Hôtel des Invalides, when I attended Larry in his rounds. He is a short and corpulent man with a very agreeable face. His hair, which is gray, falls in curls over a straight ornamented collar of the military coat he wears during his visits. He took great pains to show us all the remarkable cases. The most remarkable were one where the lower jaw was shot off; two or three of disarticulation at the shoulder joint with a beautiful union. Baron Larry is very fond of the hot iron. I saw him apply it to a large ulcer on the leg."

The lectures chosen at the School of Medicine were those of Andral and Marjolin. Marjolin was then one of the first consulting surgeons of Paris. In Paris more than two-thirds of the patients died after amputation. Dr. Warren attributed the fact to their mode of dressing, "which, in most cases, consists in stuffing the wound with lint and preventing healing by first intention. When this is not done, the number of ligatures produces the same effect and many die after leaving the hospital, worn out by the length of the cure. It seems to be rather an object to study the natural history of the disease and to perform an operation beautifully, than to save the life of the patient."

Dr. Warren's second year of study abroad began in November. He devoted himself to the stethoscope and continued his study with Louis. He formed one of a group of enthusiastic students who afterward were known as the "pupils of Louis." They were Jackson, Bowditch, Holmes, Bethune, Hooper, and Inches of Boston; Gerhard, Peace, Pepper of Philadelphia; a group of American students attracted to Paris at this period when French supremacy in medicine and the reputation of the great clinician seemed to have reached its highest point.

In London the following spring, Dr. Warren visited the hospitals and followed Bell, Guthrie, Brodie, Travers, Tyrrel, Lawrence, and Stanley. He was shown the Hunterian Museum, and at Guy's saw both Key and Bransby Cooper operate. He also attended operations at Moorfield's Hospital, the Ophthalmic Infirmary, one of the earliest institutions of its kind. It was at this hospital that

he had the opportunity to be present at a large public dinner, attended by many notables at which his classmate, Oliver Wendell Holmes, took an impromptu part in the proceedings and made eloquent reference to a similar institution in his own native town, "the Massachusetts Charitable Eye and Ear Infirmary," which had been modeled after Moorfield's. At Dublin, Dr. Warren visited Dr. Macartney's Anatomical Museum and at Edinburgh, the wards of Liston and Syme.

October 1, 1834, he returned to Paris, continuing to serve under Louis. He, also, studied at the Venereal Hospital under Ricord and took courses with Lisfranc. Dr. Warren had the opportunity to take a course in midwifery with Madame La Chappelle, the niece of the great Madame. Completing his medical and surgical studies, Dr. Warren left Paris and sailed for home, May 8, 1835. He began his practice assisting his father but took over the entire practice June 7, 1837, during the latter's visit to Europe. On April 30, 1839, Dr. Warren married Anna Caspar Crowninshield.

Dr. Warren seems to have developed a strong taste for plastic surgery. Soon after his return from Europe he performed a number of operations for rhinoplasty. One or two of these were done by the Talicotian method; a flap being taken from the arm. In later cases the Indian method was found preferable. Dr. Warren took a keen interest in staphylorrhaphy. His first cases were published in 1843 and amounted in all to about one hundred in number. His method consisted in freeing the soft part from the bone with large scissors curved on the flat, thus separating the mucous membrane from the bone. The dissection was continued until the tissues were relaxed, enabling the edges of the wound to be united with the minimum tension. He used silk thread soaked in compound tincture of benzoin and a special case of instruments which he devised. These operations included fissures of the hard as well as the soft palate which up to that time had not been attempted. Roux and others had confined the operation to the soft palate alone. The method afterward adopted by Langenbeck and usually associated with his name differed only in the use of the lateral incisions which Dr. Warren had not found necessary since he used free dissection. In 1844, Dr. Warren spent the summer abroad and this same year received the degree of A.M. from Harvard. On February 2, 1846, he was chosen one of the visiting surgeons of the Massachusetts General Hospital.

Dr. Warren was at this period but 35 years of age, and at the beginning of his career as hospital surgeon when the opportunity came for him to take a personal part in one of the greatest events in the history of surgery. He thus describes his experience and the incidents that led up to the introduction of surgical anæsthesia[1]: "In the autumn of 1846, Dr. W. T. G. Morton, a dentist in Boston, a person of great ingenuity, patience, and pertinacity of purpose, called on me

[1] Surgical Observations with Cases by J. Mason Warren.

several times to show some of his inventions. At this time I introduced him to Dr. John C. Warren. Shortly after this, in October, I learned from Dr. Warren that Dr. Morton had visited him and informed him that he was in possession of, or had discovered, a means of preventing pain, which he had proved in dental operations, and wished Dr. Warren to give him an opportunity of trying it in a surgical operation. After some questions on the subject in regard to the safety of it, Dr. Warren promised that he would do so. On the Tuesday following, October 13, after the surgical visit to the hospital, a patient was brought into the amphitheater for operation. This being the first opportunity which had occurred since Dr. Warren's promise to Dr. Morton, Dr. Warren said to us: 'I now remember that I have made a promise to Doctor Morton to give him an opportunity to try a new remedy for preventing pain in surgical operations,' and asked the patient if he would like to have the operation done without suffering. He naturally answered in the affirmative. The operation was, therefore, deferred until Friday, October 16, when the ether was administered by Dr. Morton with his apparatus, and the operation performed by Dr. Warren" (assisted by his son, Dr. Mason Warren). "It consisted in the removal of a vascular tumor of the neck. During a part of the time the patient showed some marks of sensibility, but subsequently said that he had no pain, although he was aware that the operation was proceeding. On the following day, a woman requiring the removal of an adipose tumor from the arm was rendered insensible by ether given by Dr. Morton, and Dr. Warren requested Dr. Hayward, who was present, to perform the operation. This was successful; the ether being continued through the whole operation and the patient being entirely insensible." These were followed in a few days by an amputation of the thigh by Dr. Hayward and the removal of a portion of the upper jaw by Dr. Warren. "The use of ether in surgical operations being sanctioned by the Medical Board of the Hospital, the Consulting Board, and the Board of Trustees, was after some little resistance gradually adopted throughout this country and at once made use of by surgeons in Europe. . . . . Ether was first administered by an apparatus. The use of this was inconvenient, especially with children, and led me to administer it on a cone-shaped sponge, which immediately took the place of the apparatus everywhere. The sponge first used at the hospital is still preserved there." Thus, as Dr. Warren said in an address to the Medical Society in 1864: "The full value of this immortal discovery was demonstrated publicly in our own city and under the auspices of our own body." Writing on Ether Day in 1896, Ashhurst said: "Surgeons went on in every country cutting and burning and the patients went on writhing and screaming until October 16, 1846, when surgical anæsthesia became the priceless heritage of the world."

Dr. Warren took an active part in the early work of the American Medical Association and was faithful in his attendance. It was in May, 1853, while he

was on the train with many colleagues, returning from a meeting of the association in New York that the "Norwalk Disaster" occurred, in which some 60 victims, including Dr. Pierson of Salem, lost their lives. On this occasion Dr. Warren exerted himself successfully in the resuscitation of one passenger who had been apparently drowned, besides attending to many of the injured. The strain of the events of this day bore heavily upon him for many years afterward. In 1854 and again in 1855 he visited Europe with his family, remaining on the latter occasion an extended period of time. Shortly after his return in 1856 he was finally restored to health. His father had recently died and he now entered upon the full duties of a large and successful practice.

This was a trying time in the history of surgery for the hospital surgeon. Anæsthesia had brought with it a great increase in surgical cases and operations in the hospital wards. They became crowded. The time had not yet come for the radical changes in the treatment of wounds; because of occasional unfavorable conditions, hospital pests were rampant, and the surgical wards were at times filled with cases of pyæmia, erysipelas, and hospital gangrene. The strain upon the surgeon was greater than it had been for many a day before. The writer of this article recalls his earliest experience at that time while the epidemic was still at its height and later when serving as a house officer at the Massachusetts General Hospital when conditions had improved but before the sorely needed changes had been brought about by antiseptic surgery.

A good idea of the extent of surgery at this period may be gained from an address delivered by Dr. Warren before the Massachusetts Medical Society in 1864, entitled "Recent Progress in Surgery." The topics deemed worthy of notice by the writer were: Healing of wounds, operation for stone in the bladder, methods of treating fracture, amputations (with mortality of 20.8 per cent), recent introduction of the incision of joints as an established form of treatment, tumors, injuries of the nerves, and orthopedic surgery. In abdominal surgery we find only operations for the cure of hernia and ovariotomy briefly mentioned. In 1867 Doctor Warren published his "Surgical Observations and Cases." This was, literally a last word on the surgery of that period and has today especial interest from an historical point of view for it marks the close of an era in surgery as Lister's antiseptic system was already in the making.

During the Civil War Dr. Warren had ample opportunity for seeing military surgery in the number of cases of gunshot wounds and other injuries which accumulated at a large base like that of the Massachusetts General Hospital. It was here that the writer first remembered the subcutaneous syringe which was used for the relief of pain in gunshot injuries of the nerves. All through the war Dr. Warren performed faithful service on the State Board of Examiners. His health was never robust. He was a man of delicate frame, and it was only by careful living that he succeeded in accomplishing the arduous tasks which his pro-

fession entailed upon him. In June, 1867, he wrote in his journal: "During the last four months have performed ninety operations at the hospital and thirty private ones." For many months he had been in failing health and on the day when he received his twenty-first annual appointment, he paid his last official visit at the hospital but he continued in active practice up to the last. On August 19, 1867, he died.

Dr. Warren was president of the Massachusetts Medical Benevolent Society, president of The Suffolk Medical District Society, member of the Phi Beta Kappa Society of Harvard College, member of the American Academy of Arts and Sciences, and honorary member of the Medical Society of the State of New York.

Dr. Warren was a man of agreeable personality, popular alike with his colleagues and his patients. Of him in his early student days Dr. Bowditch writes: "No one ever heard aught against him. On the contrary, the record of his life as written in the minds of all of us, was that of a pure-minded youth, devoted to high purposes of a thorough surgical education."

Of that same period Dr. Holmes' tribute refers to him as follows: "In Paris, in London, wherever we found ourselves, he never for a moment lost sight of his great object, to qualify himself for that conspicuous place as a surgeon which was marked for him by the name he bore and the conditions to which he was born. This was his constant aim in the hospitals which he assiduously followed, in the museums which he faithfully explored, and in the society of the distinguished practitioners to whom he had access and to whom he often introduced his less fortunate friends. We who know this laborious man, loved him, because he was good and natural in all his ways. I do not remember that any of us, even those who travelled with him, ever had a hard word with him."

Writing of him Henry W. Longfellow who was a patient of his, said to Dr. Warren's father: "Truly it may be said of him that he has in a high degree, 'the eagle's eye, the woman's hand'! I know he needs no commendation of mine but it is so pleasant to me to say it. I trust it will not be unpleasant to you to hear it."

His medical colleagues, always critical judges, had a high opinion of his skill. He was ever devoted to his patients and there were many instances in his practice in which four generations were attended by the Warrens. Dr. Warren was one of those fortunate men whose sense of humor lightened the cares of life. He was endowed with a fondness for children and his devotion to his family was one of his chief characteristics. Many of the traits of his grandfather, John Warren, ably described by his colleague, James Jackson, were true of Mason Warren. Dr. Jackson said: "He had that affability and dignity of true politeness. To the young and the humble he was always accessible and singularly agreeable."

J. Collins Warren.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held June 18, 1926, Dr. David S. Hillis Presiding

PREMATURE SEPARATION OF PLACENTA; PLACENTA PRÆVIA MARGINALIS

Dr. David S. Hillis: I have some pictures of two specimens, a case of premature separation of the placenta and a case of placenta prævia marginalis. In both cases the patients died undelivered. These are of interest to the society only because of the rather rare opportunities we have for seeing such cases. I got a picture of the placenta in position in the uterus, and two pictures of the case of placental separation which show the extreme amount of hæmorrhage and the outside of the uncut uterus. In the case of placental separation, the blood clot can be seen in the upper right-hand corner of the placenta attachment. The patient died of hæmorrhage. She bled all night and then was brought into the hospital. It was about a full term pregnancy.

PYONEPHROSIS OF THE RIGHT KIDNEY; BIFURCATED URETER

Dr. W. M. Thompson: I have 2 cases which I hope will be of interest to the society, one of pyonephrosis of the right kidney complicated by large parovarian cyst, the other of bifurcated ureter with apparent double left kidney and normal right kidney.

Case 1. Mrs. H., age 37, widow, was admitted to Henrotin Hospital on April 19, 1926, with diagnosis of right pyonephrosis, kinked ureter, and retroperitoneal parovarian cyst. The present complaint was frequent urination, sometimes bloody, with pain in the back and right side extending from the region of the right kidney, intermittent and reaching severe paroxysms. The patient stated that a few days previously she had had a sudden attack of frequent urination with pain in the bladder and in the right side which became worse the night before she entered the hospital when she suffered a chill lasting 10 minutes. About 2 months previously she suffered a similar attack, but at that time it lasted but one day. The past history showed the usual diseases of childhood, uterine hæmorrhage 2 months ago, last period normal, no miscarriage, no leucorrhœa. The patient slept well, had fair appetite, bowels were regular; urination caused a burning sensation, was frequent and painful. Physical examination showed pain on pressure over the right kidney extending down to the bladder. Bimanual palpation of the kidney elicited pain. A large cyst filled the right side of the pelvis and extended up to the umbilicus, displacing the uterus to the left side. Laboratory findings: Urine cloudy, amber, acid, no sugar, slight trace of albumin; specific gravity 1010, amount in 24 hours 1440 cubic centimeters, bacillus coli plus many leucocytes. Blood: On April 20 the leucocytes were 12,000; on May 14, 6,500; erythrocytes, 3,900,000; hæmoglobin, 80 per cent. The cystoscopic examination was done by Dr. Cottrell. The bladder was filled with a cloudy fluid, with no apparent pathological condition in the trigone. On ureteral catheterization there was constant secretion from the right kidney, which was cloudy with pus. Phenolsulphonephthalein given intravenously appeared after a 15-minute period; the time of appearance from the right kidney was 11 minutes, output 1.5 per cent, many bacillus coli cells; left kidney, time 7 minutes, output 5 per cent, no pus bacteria. The pyelogram showed a right large hydronephrotic kidney with ureter dilated and kinked in a characteristic sigmoid kink.

Operation was performed April 24, and through a right oblique loin incision the kidney was delivered and found to have a large sacculated pelvis. The lower half was most dilated; the pelvis contained pus. It was opened over the lower half, the pus cleaned out and a portion of the pelvis removed to reduce its size. The kidney was drained through the cortex by a No. 12 catheter in the usual manner. This first operation was done to relieve the patient and to build up her resistance for the second operation. The second operation was performed May 14 for the removal of the cyst. It was a right parovarian retroperitoneal cyst, pyramidal in shape, dividing the broad ligament with the tube as the apex of the pyramid. The base rested on the right pelvic plane and the ureter and pelvic vessels lay beneath the base, somewhat displaced. The diagnosis was right pyonephrosis, dilated kidney pelvis, kinked ureter, and right parovarian cyst. The patient suffered the usual postoperative discomfort, but was able to be up and left the hospital May 30 in good condition.

Case 2. Mrs. P., age 38, was admitted to the hospital May 31 with a diagnosis of pyonephrosis and double ureter, and discharged June 6. The pelvis and calyces of the upper pole of the kidney were

rudimentary. The appearance was that of two kidneys. The present complaint was pain on the left side extending from the lower lumbar region down to the bladder, with chills followed by sweats. No œdema was present. The former weight was 167, now 147 pounds. There was no pain at the last menstrual period. The past history showed the patient to be a iii-para. Seven years ago she was laparotomized for uterine trouble. She complained of pain on pressure over the left kidney. Vaginal examination and bimanual examination of the bladder was painful. The X-ray showed bifurcated left ureter, one portion extending to the upper pole of the kidney and the lower to the lower pole of the kidney. Pelvis and calyces in the upper pole were rudimentary. Laboratory findings: The urine was amber in color, acid, specific gravity 1018, negative for sugar and albumin, no casts. Ureteral catheterization showed many pus cells from the left side; right, negative. Secretion from the left side was much slower.

This patient refused operation. She will probably lose the upper lobe, possibly the lower lobe, sooner or later, but she left the hospital without operation.

PLACENTA WITH MANY INFARCTS

Dr. Bacon: This specimen is a placenta which shows very well a large number of infarcts. Here are some glands from the same patient.

The patient was a woman about 36 years of age, a half idiot, who came to the Salvation Army Hospital about 5 weeks ago. A large amount of albumin was present and the blood pressure was 205. According to the size of the uterus she was considered about 28 weeks pregnant. We had no history of menstruation or fetal movements. She was put to bed and treated as we ordinarily treat these patients, with some doubt as to the desirability of continuing pregnancy. We secured from her relatives permission to sterilize her if any operation was done. She had a very small pelvis. She improved somewhat under treatment, the albumin decreased, and the blood pressure went down to 165, therefore we decided to continue the treatment in spite of the fact that she was of low mentality and that the father of the child was the girl's uncle. The patient was kept in bed, in about the same condition mentally, and made no particular complaint until a week or 10 days ago when the albumin increased in the urine and she became more dropsical, but the blood pressure did not increase. The uterus ceased to enlarge and yesterday I found it smaller than 5 weeks before. We then decided to do a laparotomy and remove the fetus and sterilize the woman, as we had permission to do, but she died several hours later while she was alone in the room. A postmortem by Dr. Sweeney revealed a uterus of the size found antemortem that held a slightly macerated fetus 38 centimeters in length, corresponding to an age of about 30 weeks. The kidneys were small, with small cortex, and presented a typical picture of chronic nephritis. The large number of infarcts in the placenta might have accounted for the death of the fetus.

I would like to ask the opinion of the fellows in regard to the treatment of a case of this kind. Would I have been justified in emptying the uterus and sacrificing a child of low type while the patient was in a condition to stand it?

DISCUSSION

Dr. Sweeney: We did not find anything that would account for the sudden death. Two hours before death the patient was apparently in good condition. Death in a case of that kind is to be expected, but not in such a sudden and unexplainable manner. There was no evidence of convulsions, but about 2 centimeters from the base there was evidence of interstitial pneumonia in both lungs.

Dr. Baer: Having in mind the fact that Dr. Bacon was giving conservative treatment, I would ask if venesection was a part of that conservative treatment. The treatment he has outlined was all indicated, but I would have added a massive venesection as a prophylactic.

Dr. Culbertson: We are apt to overlook the possibility of placental infarction in acute infections. Many of the fetal deaths, as for example in the influenza epidemics, may be due to that. This winter I had a case of fetal death *in utero* after an attack of influenza, and the placenta in that case showed as many infarcts as the one here presented.

Dr. Bacon (closing): The patient made so little complaint that thorough examination was not made yesterday; in fact I had not seen her myself for several weeks before she died, and the last examination was not as thorough as it should have been or I would have discovered the pneumonia.

Dr. David S. Hillis read a paper entitled "Rotation of the Posterior Occiput."

BRADYTOCIA: A STUDY BASED ON 500 CASES IN THE CHICAGO LYING-IN HOSPITAL

Dr. D. A. Horner presented a paper on "Bradytocia, a Study Based on 500 Cases in the Chicago Lying-In Hospital." (See p. 194.)

DISCUSSION

Dr. W. G. Lee: The subject, dystocia, should be restricted to the functional causes for prolongation of the process of labor. Also some agreement should be reached as to the proper definition of labor. In very prolonged labors it is important to know the frequency, intensity, and duration of uterine contractions. What constitutes false labor as differentiated from true labor? The difference cannot be in the presence or absence of pain, for there are painless labors. So it would seem that uterine contractions not producing effects are much more accurately spoken of as prodromal pains rather than false labor pains; for false labor to many connotes abdominal

pains not arising from uterine contractions. In Group A, Table III, the cases are those of primary inertia and dry labor. This term, primary inertia, is unsatisfactory because inertia implies cessation of uterine contractions, and in many of these cases the uterine contractions continued over long periods, therefore the uterus was not inert.

Dr. Horner speaks of dry labor but does not give any specific import to oligohydramnios of marked degree, although this is essentially a concealed dry labor; and in a series of cases at the Cook County Hospital the concealed dry labors were as numerous as the frank dry labors. Dr. Horner has left out entirely the third universally regarded important factor in labor, the passenger, though he spoke specifically of the powers and passages. The fetus is often considered the only passenger; but in differentiating the abnormal case it is helpful to consider that normally the first passenger is "the waters," the second the fetus, and the third the placenta with the membranes. In dry labor the fetus becomes the primary passenger too soon and has to dilate the cervix, which is ordinarily dilated by the amniotic fluid.

Proper analysis of these cases with the consequent change in classification would result in different treatment. For instance, in a transverse presentation the essential thing is a disproportion purely functional, and if the fetus is turned we usually secure a normal proportion immediately. Likewise in malpositions, particularly in cases of posterior position, is there not too often failure to recognize that a partial extension of the head has occurred and that the inability to rotate normally is the result of disproportion or the absence of a leading point?

What is needed is early accurate analysis. "Watchful expectancy" is a mischievous term. In dry labors and in concealed dry labors, women are allowed to become exhausted because the obstetrician fails to recognize the abnormal factors. For instance, the uterus may be contracting very well but no progress is made because abnormal resistance has developed. Then treatment of the cervix manually or by bags often does not reach the seat of the trouble which may be above the fetal head. For example, in one of my early cases, the mother had increasingly severe painful uterine contractions for some hours without progress, yet the cervical tissues were quite lax. Under ether anæsthesia the cervix was manually dilated without difficulty. The head rocked easily yet resisted extraction by forceps as though impacted. A constriction ring much more resistant than the cervix was found in front of the shoulders. Its development was due to oligohydramnios.

Dr. C. S. Bacon: I would like to make a few objections to some of the terms used. Twenty hours is generally accepted as the average length of labor in primiparæ, but actually the length is more in many cases. However, that being the average length, we should not call 22 or 24 hours bradytocia, but 30 hours or more.

The terms primary and secondary inertia as causes of bradytocia are not appropriately applied. Secondary inertia means that contractions have started well and then died out for some reason. Premature rupture of the membranes should not be classed with secondary inertia. Rupture of the membranes may be an important factor in bradytocia but for the reason that it has a very large bearing upon dystocia of the passages.

I was surprised that the speaker did not mention one very frequent cause of prolonged labor, slow dilatation of the cervix. The cervix differs very much in dilatability, a very important factor in bradytocia.

As to treatment, I have even more confidence in sedatives than Dr. Horner has. I believe labor can be carried on for 90 or 100 hours and still be spontaneous. I would not think of interfering because of the duration of labor alone. The length of labor is influenced very much by expectant treatment. A series showing operation in 58 per cent of the cases reveals nothing as to the average length of time of labor in non-operative cases. I believe that a table showing operation in 10 per cent or 20 per cent of the cases would give a very different description of bradytocia, and I am inclined to think that the morbidity and mortality of both mother and child would be less. High forceps especially lead to very high mortality. In other words, I believe in conservative treatment—it is more desirable than the operative treatment that has been described here tonight. As to bringing on a labor in a case of suspected bradytocia, that is also a rather questionable procedure. Most of these cases are in primiparæ and in case of no great contraction of the pelvis, to decide upon interference by induction of labor or cæsarean section would tax the judgment very strongly. I take exception to the view that one should not allow more than 2 hours for the second stage. I would not be afraid of extension of this stage.

Dr. R. A. Scott: I was surprised at the large number of cases in which Duehrssen's incision was used. I use the incision infrequently, and I fear its effect on subsequent labors. Would not these cases require section at the next labor? I imagine the scar tissue left would be almost equal to that following manual dilatation.

Dr. J. L. Baer: This admirable analysis of a series of cases of slow labor contains valuable data. I would like to comment on one point that is quite contrary to my own experience, namely, the frequent occurrence of post-partum hæmorrhage requiring manual removal of the placenta and intrauterine tamponade. Manual removal is rare in my experience, and I believe post-partum hæmorrhage can be controlled, after such removal if necessary, without the tamponade. I am sure the procedure at the Chicago Lying-In Hospital includes pituitrin in the third stage and I am interested to know if the large number—one-half—who had manual removals were thus treated.

Dr. D. A. Horner (closing): First I want to thank those members who discussed my paper for

giving me a number of new factors to consider. I will try to answer Dr. Lee by saying that my definition of labor includes only uterine contractions plus dilatation of the cervix; it does not include pain and consequently would fit in well for painless labor. I am also thankful to him for calling my attention to the fact that the membranes and the placenta are also to be considered passengers. That is quite correct and in working up this paper more fully, I shall consider this point. I could not go into details of treatment of any single malposition because to do so would include practically every phase of obstetrics and would make this quite a volume. There has been so much written on posterior occipital position that it would be out of order to include it in this paper.

About the management of the contraction ring, I must take exception. Watchful waiting would include knowledge of the presence of that ring and all other factors, and the contraction ring being evident, treatment must be directed toward that ring. In order to deliver the patient from below, it is sometimes necessary to anæsthetize her deeply, even to the point of danger. After the introduction of the hand up to the contraction ring to dislodge one shoulder from the grasp of the ring, one can go about delivering the fetus. It is not good technique to perform version and extraction in the presence of a contraction ring, but I have seen it done without damage to the mother.

If, as Williams says, 14 hours is a normal labor length (for multiparæ), then surely 24 should be considered bradytocia. For that reason I have taken this point as the lowest limit. I believe that a little longer time would exclude a certain number of cases I have included, but bradytocia has no recognized time limit except being beyond normal and we must start somewhere. The time limits set by Williams and De Lee are exceeded by hours.

The reason I have divided the first group into primary and secondary inertia is simple. Primary, as was said, requires no explanation; secondary applies to cases in which there is a diminution of the powers. At first contractions were sufficient to accomplish part of their purpose and then subsided and were no longer efficient. No other important factor was present to interfere with labor.

I do not think that 58 per cent of operations in a group of 500 cases of bradytocia is too large a proportion, when one considers that these are our worst cases. I do not believe that cases in which labor goes on indefinitely without result should be treated in any other way than by operation. It is our object to relieve a woman in labor, and if we can do so by any means that will leave her better off than she would be by continued labor, the operation ought to be done. Allowing a labor of 100 to 130 hours in the hope of spontaneous delivery is really too much to demand of her. In order to help her there is nothing to do but to interfere.

I believe 2 hours in the second stage is a severe strain on the patient. If labor is allowed to continue for more than 2 hours, a ruptured uterus and dead baby are to be considered.

Dr. Scott questioned the large number of Duehrssen incisions. Ten per cent is a relatively low number when one considers how often in the past one has been tempted to employ manual dilatation which in reality is a cruder way of accomplishing the same result. Almost every time I have inspected a cervix dilated manually I have found it torn extensively. Is it not better to incise than to lacerate? If one goes about it gently, dilatation can be accomplished without laceration, but in a great number of cases it cannot be done. Now as to the effect on the second or third labor. I have delivered patients several times after the Duehrssen incision, without complications. In some cases there were cicatrices which made incision again necessary. The question of leucorrhœa I have not considered but I believe it is possible to have Duehrssen's incision without subsequent leucorrhœa. I have in a number of cases omitted sewing the incisions, as recommended by the Germans, but in such cases I expected leucorrhœa. That is one of the penalties the patient has to pay for bradytocia. I mentioned that bradytocia was accompanied by a great many difficulties in after life, and this is one of them.

Dr. Baer spoke of the frequency of postpartum hæmorrhage and manual removal of the placenta. We are practically unanimous in trying to save blood. These patients undergo anæsthesia very poorly and bleed freely; and rather than keep them on the table under ether waiting for placental separation we do not consider it bad form to shorten the third stage by removal of the placenta. Again I must say that physical exhaustion is conducive to uterine decompensation and hæmorrhage. The patient should be put to bed as soon as possible after the delivery and treated for her extraordinary exertions by fluids, bicarbonate of soda, and glucose.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED BROWN, M.D., F.A.C.S., Omaha, Nebraska

THE ABSTRACT OF SEA SURGERY BY JOHN MOYLE

IN 1686 a little volume entitled *Abstractum Chirurgiae Marinae* (an abstract of Sea Surgery)[1] was printed in London by J. Richardson for Tho. Passinger at the 3 Bibles on London Bridge after Licence had been obtained by Robert Midgley on May 25th. It was written by one John Moyle, Sen., who on the title page describes himself as "sometime a Sea Chirurgeon in His Majesties Service." Of Moyle I can find no record and we must depend on his short introduction in which he informs us that at this time (1686) he was somewhat advanced in years and had served actively. There is also a somewhat pathetic note in this introduction where he speaks of being out of employment, but it may be well to quote his own words to the Surgeon General of the Navy and the Masters, or Governours of Chirurgeons-Hall, London.

"It is not unknown to some of you, if not to all, that by your appointment I have had the Honour to be a Sea Chirurgeon (for not a few years) in His Majesties Service; and now I find myself in years, and connot expect to hold it much longer at Sea; which turbulent Element requires the best of a Mans Age in whatsoever Capacity he comes there to serve. But before my Exit I resolved to write this Abstract, according to what Skill and Experience I have attained for the use of others of my Calling, who are the true Sons of Esculapius, and either are, or would be Sea-Chirurgeons, yet whose younger years or non opportunities have not permitted them to aim at that degree of Experience, as is requisite; but are either altogether unacquainted with the Sea Practice, or at least waies have not been in Ingagements, and so need Instruction. I undertake this, not that I think better of myself than of all other Sea-Chirurgeons; for there are some who were my contemporaries in the Wars, and their Knowledge I esteem as good, and some better than my own: But I undertake to write this because I see others have not: And indeed being at present out of Imploy, I have more leisure time than others, or then my self desires, If I could remedy it: However at this juncture it falls out opportunely to me to write it, and especially for some reasons urging. Now as I have had at all times my Imployments from Your Worshipful Company, so I humbly Dedicate this Book unto you." etc. From this, one gets a vision of an old broken down man, no longer able to follow the sea as a surgeon, who must step out of the picture, and allow his place to be taken by a younger man, trying to aid the young man suitably to fill his place. There was probably also the matter of money and self support for he speaks of his non-employment and later adds he wrote it "especially for some reasons urging," which might have been financial.

The book breathes the sea from cover to cover. At first the fitting out of the sea chest and choosing the proper medicines and dressings according to the type and length of voyage and the destination of the ship. There is nothing of civil surgery for the author says: "I do not design here to teach you to be a Chirurgeon, but will suppose you to be one already. But I intend to teach you to be a Sea-Chirurgeon, for by that time you have read this Book, you will find that a man may be an Ingenious Practitioner at Land; and yet, if he comes to Sea, be far to seek, being unacquainted with the Sea Practice: Nay, you may have been at Sea, and yet (if not in a sea fight) you will be to seek, not knowing how to behave yourself at such a time." So in the second part the author takes us into action. We are in a Man-of-War and are taught how to prepare the platform below decks and get our material ready at hand. Our operating space is lighted by candles and everything in readiness when "By this time I'le suppose the fight is begun, and your ship is ingaged, and wounded men begin to be brought down: And the first one, who to save his life, must have his limbs amputated." Later minor injuries are described, each one minutely, even to the dressings and ointments to be used. Through it all, so vivid are the descriptions that one can sense the action and almost feel the ships come together and the grappling irons take hold, followed by the boarding and hand to hand fighting. The mind carries us back nearly a century and we seem to feel ourselves in a ship attacking the Armada with Drake, Raleigh, or Essex in Command and participating in the later campaigns (in which Moyle probably took part) which were to result in making Britannia ruler of the seas.

But the actual surgery is disappointing in its crudity. The lessons of Paré are apparently forgotten. The ligature is not mentioned, and the cautery and pressure are used in its place. Circular amputation is advocated and the saving grace of removal of foreign bodies. Again as so frequently found in the surgeries of this time, water and constant washing of wounds is consistently employed.

[1] Courtesy of Dr. LeRoy Crummer, Omaha, Nebraska.

Abſtractum Chirurgiæ Marinæ.

An ABSTRACT of SEA CHIRURGERY:

Deſigned for the uſe of ſuch Chirurgeons who deſire to ſerve at Sea, yet are unacquainted with Sea practice: In order to their reſtoring to Health of Sick or Wounded Sea-men; But may all fitly ſerve for moſt Chirurgeons.

In Three Compendious Books.

The Firſt containeth certain Directions neceſſary to be obſerved by the Sea-Chirurgeon in his fitting out.

The Second teacheth how he ſhould perform his Chirurgical Duty being at Sea, both in an ingagement, and at other times.

The Third inſtructeth how he muſt execute the Phiſical office impoſed on him.

By *JOHN MOYLE* Sen. ſometime a Sea-Chirurgeon in His Majeſties Service.

Licenſed, *May* 25*th.* 1686. *ROB. MIDGLEY.*

London, Printed by *J. Richardſon* for *Tho. Paſſinger*, at the 3 Bibles on *London-Bridge*. 1686.

REVIEWS OF NEW BOOKS IN SURGERY

THE constant improvement in urological methods would seem to necessitate frequent revisions of standard textbooks on urology. Lowsley and Kirwin[1] have presented not only the practitioner and student but the urologist as well with a clearly outlined, readable, and graphically illustrated textbook on this subject. It might well be adopted as a standard for medical students. While any complete treatise on special subjects is unfortunately too voluminous for the reading time allowed the average medical student during his period of active study, familiarity with this textbook would undoubtedly stimulate a more thorough reference later on.

Gonorrhœa in the male is discussed in a concise manner, the usual complicated classification being omitted. Wherever possible the separate organs or individual parts of the genito-urinary system are dealt with in logical sequence in a single chapter. As would be expected from Lowsley, the sections devoted to embryology are most complete but are in due proportion to their practical application. All of the subject matter is in accord with generally accepted modern methods. Regional anæsthesia is thoroughly discussed and illustrated. The bibliography is complete and up to date and should open the avenue for more extended study of original articles if the reader is seeking more detailed information on some special subject.

VINCENT J. O'CONOR.

NO brief review can sufficiently evaluate the methods described by Wyeth in his book on electrothermy in the surgery of neoplastic diseases.[2] It deserves the careful consideration of every medical practitioner and specialist.

The interesting preface by Kelly points out in a concise manner the "beneficent utility" of endothermy in the treatment of accessible forms of malignancy. The first chapter reviews the varied terminology which has confused the literature, Wyeth stating clearly his reasons for preferring the term endothermy to others in common use such as diathermy, electrocoagulation, and thermocautery. In brief, he believes that the term endothermy should comprehend desiccation, coagulation, and the endotherm knife and exclude fulguration, electrolysis, and cauterization.

The history of high frequency currents and their mode of production are considered in the second and third chapters, Mutscheller contributing an excellent explanation of the latter. Monopolar and bipolar endothermy and the endotherm knife are discussed in subsequent chapters with both theoretical and practical considerations for their usage. There follows a résumé of the wide experience of the author, supplemented by free reference to the work of others. Accessible neoplastic lesions of mucous membranes and skin, both benign and malignant, are taken up in separate chapters. Each subject is accompanied by specific case reports, actual photographs of the areas before and after treatment, and in many instances photomicrographs of the tumor tissue.

No previous work on this subject which has come to the attention of the reviewer has been so carefully compiled. The scientific proofs presented leave no doubt as to the efficiency of electrothermic methods in this group of otherwise frequently hopeless cases.

VINCENT J. O'CONOR.

THE less showy form of study still continues to attract a few real thinkers. The exhibition forms of experimental and physiological surgery continue, however, to hold the medical eye. Monographs such as that by Knaggs[3] on the diseases of bone, rarely appear.

The clinical scientifically seasoned ideas of a surgeon who has relinquished his active work are always valuable. When they cover a field in which the voluminous literature is chaotic and frequently antagonistic, and are put into one handy volume, they are indeed a source of relief to the student and teacher. The essential points of bone inflammation and disease are presented in simple form.

In an easy manner so characteristic of our British cousins the author deals with the inflammations and diseases of bones. The chapter on yaws is valuable. The included Hunterian lectures on Paget's disease, leontiasis ossea, and osteomalacia are very good. The illustrations are attractive, subdued, yet authoritative, representing material from the Museum of the Royal College of Surgeons and elsewhere. The reviewer notes the inclusion of the best of our work from the United States.

KELLOGG SPEED.

AN Edinburgh orthopedic surgeon[4] who has had considerable training and experience in American orthopedic surgery presents a valuable contribution on orthopedics. From this text the student may gain an understanding of the scope, principles, and essential details of orthopedic surgery in its relation to pathology and general medicine and surgery. The author emphasizes the early recognition and treatment of conditions which usually lead to deformity and disability. He presents the point of

[1] A TEXTBOOK OF UROLOGY. By Oswald Swinney Lowsley, A.B., M.D., F.A.C.S., and Thomas Joseph Kirwin, Ph.C., B.S., M.A., M.D. Philadelphia and New York: Lea and Febiger, 1925.

[2] SURGERY OF NEOPLASTIC DISEASES BY ELECTROTHERMIC METHODS. By George A. Wyeth, M.D. Preface by Howard A. Kelly, M.D. New York: Paul B. Hoeber, 1926.

[3] THE INFLAMMATORY AND TOXIC DISEASES OF BONE: A TEXTBOOK FOR SENIOR STUDENTS. By R. Lawford Knaggs, M.C. (Cantab.), F.R.C.S. New York: William Wood and Company, 1926.

[4] ORTHOPÆDIC SURGERY. By W. A. Cochrane, M.B., Ch.B., F.R.C.S.E. New York: William Wood and Company, 1926.

view of Goldthwait on the structural and functional conceptions of disease, and discusses body mechanics and posture, the various anatomical types, the importance of reconstruction in the patient with chronic conditions such as arthritis, and physical education in its relation to medicine. The subject of muscle tone and spastic paralysis is brought up to date.

The style of the author is good. The diagrams and sketches, especially those on posture, are excellent. The book is offered to the student as a supplement to the various textbooks on orthopedic surgery.

PHILIP LEWIN.

THE second edition of Dr. Einhorn's little book[1] on the duodenal tube is interesting and stimulating. In a field in which definite conclusions have not been arrived at, his technique and diagnostic criteria are valuable but certainly not final. The diagnosis of gall-bladder disease from the study of the microscopic findings in a specimen from the duodenum is as yet not on a firm basis but the results are suggestive. The work of Chester Jones is corroborative in this connection. The section on duodenal alimentation emphasizes a use of the duodenal tube which should be widely recognized. The book is readable and worth while for anyone interested especially in the study of the duodenum.

PAUL STARR.

IN his book on the surgical treatment of goiter,[2] Bartlett has attempted to sum up all the knowledge which the surgeon would find of a practical nature. In fact, practicability might be mentioned as the keynote of this book. All the way through, emphasis is laid upon those facts which are of daily value in the handling of goiter patients. Louis B. Wilson's chapter on pathology carries out this same principle as do also the chapters on the heart by Grant and laryngeal complications by Hansel.

Starting in with a very brief history of goiter, the author proceeds step by step from pathology to indications for operation and preparation of the patient through the stages of four different types of thyroidectomy, and concludes with discussions of various complications, recurrences, and after-treatment. The final chapter entitled the "Ideal Goiter Clinic" is not simply a Utopian idea but a plea for close correlation in goiter work between the various specialists such as roentgenologists, pathologists, internists, surgeons, etc.—a correlation which at present exists in all the important goiter clinics but which should exist wherever the surgical treatment of goiter is undertaken.

The book is well illustrated. The printing is excellent and the general arrangement logical and therefore easy to follow. RALPH B. BETTMAN.

[1] THE DUODENAL TUBE AND ITS POSSIBILITIES. Max Einhorn, M.D. 2d ed. Philadelphia: F. A. Davis Company, 1926.

[2] THE SURGICAL TREATMENT OF GOITER. By Willard Bartlett, A.B., A.M., M.D., D.Sc., F.A.C.S. Foreword by Charles Mayo. St. Louis: The C. V. Mosby Company, 1926.

SCUDDER'S "Treatment of Fractures"[3] has been for years the best American textbook covering the subject. The fact that it has successfully gone through nine editions and is now appearing in its tenth and the fact that it is one of the well thumbed books in any medical library, are mute evidences of its popularity.

The ability to cover a subject carefully, to present the subject from the point of view of the expert, and to do this in such a manner that the reader can refer quickly to the particular section he desires, find the facts for which he is seeking, and find these facts presented in a clear, logical and interesting manner, is a gift possessed by few authors. For this reason the reviewer is delighted to see that this book is to be kept up to date. The tenth edition maintains the high standard of its predecessors; more cannot be said. RALPH B. BETTMAN.

PHYSICAL therapy is the scientific treatment of disease by various non-medical measures. A book on physiotherapy by Sampson[4] gives many excellent points on the use of physical means, but the clinical results as given show many extravagant claims as to their value. JOHN S. COULTER.

BLUMBERG[5] presents a textbook of topographic anatomy which is an excellent co-ordinating medium between that great mass of anatomical detail which the physician is called upon to master and its application to his practice. Gross anatomy has the reputation of being one of the most important subjects in medicine and at the same time one of the most poorly known. To meet this deficiency, the medical school usually requires some anatomical work in the latter part of the course, this being variously known as surgical anatomy, applied anatomy, or topographic anatomy. The physician makes it a practice to have on hand some convenient text of anatomy for ready reference, and to make his subject a vivid living one to his class the teacher attempts to include in his course as much of practical reference to clinical work as he can. Blumberg's task in writing a text such as the present one is that of arranging facts in a clear and logical fashion—no mean task.

Both the anatomical and the clinical phases of the subject are well handled. The author has not presumed to present a text of operative surgery and does not go into lengthy descriptions of operative procedures which naturally belong to such a book, nor does he consume time in the repetition of tedious anatomical facts and data which belong in the systemic anatomies. The descriptions are concise and well developed, the illustrations well chosen and

[3] THE TREATMENT OF FRACTURES WITH NOTES UPON A FEW COMMON DISLOCATIONS. By Charles Locke Scudder, A.B., Ph.B., M.D., F.A.C.S. 10th ed. rev. Philadelphia: W. B. Saunders Company, 1926.

[4] A PRACTICE OF PHYSIOTHERAPY. By C. M. Sampson, M.D. The C. V. Mosby Company, 1926.

[5] LEHRBUCH DER TOPOGRAPHISCHEN ANATOMIE MIT BESONDERER BERUECKSICHTIGUNG IHRER ANWENDUNG. By John Blumberg. Berlin: Urban and Schwarzenberg, 1926.

reproduced. No sacrifice is made, however, for the sake of brevity

The book is divided into eight chapters, the subjects being the chest, the abdomen, the pelvis, the back, the lower extremity, the neck, and the upper extremity. First is given what information can be gained from inspection and palpation of the part under consideration with a discussion of the changes produced by certain pathological conditions and the value of certain landmarks from the standpoint of diagnosis or operative procedure. Next is described the skin over the part and its peculiarities and differences. Following this the subcutaneous tissues and then the muscles of the region are discussed. Then come such special descriptions as are necessitated by the particular part under consideration.

The chapters on the head and neck are especially well written. The book can be heartily recommended as a valuable addition to any surgical library. MICHAEL L. MASON.

DORLAND and Hubeny[1] have supplied a long felt need in this timely book on X-ray in embryology and obstetrics. It is well written and adequately illustrated, the X-ray cuts being particularly clear. The literature has been thoroughly covered and correlated, yet the book reads smoothly The arrangement of the material is excellent.

There is no question but what the X-ray is assuming a more important place in obstetrics. As yet, however, we are not able to solve many of the problems which confront obstetricians, such as the accurate measuring of the pelvic inlet and the diagnosis of multiple pregnancy and fetal deformities. This work will perhaps stimulate the authors and others to greater effort. EDWARD L. CORNELL.

THE appearance of a volume[2] which combines the experience of Dr. Kennedy with the inheritance that he received through personal association with Dr. Price is of great interest to all surgeons. It is a report of various types of operations based upon brief case reports. It is not a systematic review of the entire subject of operative surgery but rather a description of isolated operations as approved in the clinic of Dr. Price. It covers a rather wide range of subjects such as appendicitis, various gynecological operations with an extensive discussion of various phases of abdominal surgery, and hernia. It is well illustrated and is unique in that it is the report of the personal work and ideas of a surgeon of wide experience.

[1] THE X-RAY IN EMBRYOLOGY AND OBSTETRICS. By W. E. Newman Dorland, A.M., M.D., F.A.C.S., and Maximilian John Hubeny, M.D., F.A.C.S. St. Paul: Bruce Publishing Company, 1926.

[2] PRACTICAL SURGERY OF THE JOSEPH PRICE HOSPITAL. By James William Kennedy, M.D., F.A.C.S. Philadelphia: F. A. Davis Company, 1926.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

INDEX OF THE COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION, 1884 TO 1925. Philadelphia: W. B. Saunders, 1926.

ANATOMIE DES NERFS CRANIENS ET RACHIDIENS; ET DU SYSTÈME GRAND SYMPATHIQUE. CHEZ L'HOMME. By A. Hovelacque. Paris: Gaston Doin et Cie, 1927. vols. i and ii.

THE PATHOLOGY AND TREATMENT OF DIABETES MELLITUS. By George Graham, M.A., M.D., F.R.C.P. 2d ed. New York: Oxford University Press, 1926.

LES NÉOPLASMES ET LEUR THÉRAPEUTIQUE MÉDICALE. By Ed. Baronaki. Paris: Norbert Maloine, 1927.

ANNALES DE LA CLINIQUE CHIRURGICALE. LES PANCRÉATITES AIGUËS CHIRURGICALES. By Pierre Brocq. Paris: Masson et Cie, 1926.

CANCER DE L'OESOPHAGE. By L. Bérard and A. Sargnon. Paris: Gaston Doin & Cie, 1927.

INNERVATION DES ORGANES GÉNITAUX DE LA FEMME; DÉDUCTIONS CHIRURGICALES. By Le Docteur Robert Segond. Paris: Gaston Doin et Cie, 1926.

LA PRATIQUE CHIRURGICALE ILLUSTRÉE. vol. x. By Victor Pauchet. Paris: Gaston Doin et Cie, 1927.

THE PROSTATE GLAND. Chester Tilton Stone, M.D. New York: Allen Ross & Company, 1926.

ETIOPATOGENIA Y TRATAMIENTO DE ALGUNAS GINECOPATIAS. By Dr. Rafael Araya. Buenos Aires: Imprenta Mercatali, 1926.

MODERN CLINICAL SYPHILOLOGY; DIAGNOSIS, TREATMENT, CASE STUDIES. By John H. Stokes, M.D. With the co-operation of Paul A. O'Leary, M.D., and William H. Goeckermann, M.D., and Loren W. Shaffer, M.D., and Cleveland J. White, M.D. Philadelphia: W. B. Saunders, 1926.

DIE AKUTEN EITRIGEN INFEKTIONEN IN DER CHIRURGIE UND IHRE BEHANDLUNG. By Dr. med. Arthur Buzello. Berlin: Urban & Schwarzenberg, 1926.

BIOLOGIE UND PATHOLOGIE DES WEIBES; EIN HANDBUCH DER FRAUENHEILKUNDE UND GEBURTSHILFE. By Josef Halban and Ludwig Seitz. Lieferungen 27 and 29. Berlin: Urban & Schwarzenberg, 1926.

CHIRURGIE DE L'ESTOMAC. By Henri Hartmann. Paris: Masson et Cie, 1926.

TRAVAUX DE LA CLINIQUE CHIRURGICALE DE LA SALPÊTRIÈRE. By A. Gosset. Paris: Masson et Cie, 1926.

THÉRAPEUTIQUE CHIRURGICALE. By P. Lecène and R. Leriche. vol. i. Généralités—Membres. By R. Leriche. vol. ii, with collaboration of F. Lemaitre. Tête, Bouche, Cou, Thorax, Glande Mamaire, by P. Lecène. Rachis, Bassin, by R. Leriche. Nez, Oreilles, Larynx, by F Lemaitre. Paris: Masson et Cie, 1926.

DIAGNOSTISCHE UND THERAPEUTISCHE IRRTUEMER UND DEREN VERHUTUNG; CHIRURGIE. By Prof. Dr. J. Schwalbe. 8th vol. Peritoneum. By Prof. Dr. O. Kleinschmidt.

Appendicitis. By Geh. Med.-Rat. Prof. Dr. E. Payr. By Prof. Dr. J. Hohlbaum. Leipzig: Georg Thieme, 1926.

Archiv und Atlas der normalen und pathologischen Anatomie in typischen Roentgenbild. By Prof. Dr. Eugen Joseph. Leipzig: Georg Thieme, 1926.

The Medical Department of the United States Army in The World War. vol. xiv. Medical Aspects of Gas Warfare. Prepared under the direction of Maj. Gen. M. W. Ireland, Surgeon General. Washington: Government Printing Office, 1926.

The Scientific Basis of Chemotherapy. By Iwan I. Ostromislensky, Ph.D., M.D. Part 1. New York: Inter-American Medical Publishing Company, 1926.

Principles of Diagnosis and Treatment in Heart Affections. By Sir James Mackenzie, M.D., F.R.S., F.R.C.P., LL.D., F.R.C.P.I.(Hon.), and James Orr, M.B., Ch.B. 3d. ed. New York: Oxford University Press, 1926.

A Textbook of Embryology. By Harvey Ernest Jordan, A.M., Ph.D., and James Ernest Kindred, M.A., Ph.D. New York: D. Appleton & Company, 1926.

Clinical Surgical Diagnosis, for students and practitioners. By F. de Quervain. Translated by J. Snowman, M.D. 4th ed. New York: William Wood & Company, 1926.

Human Pathology; a textbook. By Howard T. Karsner, M.D. with an introduction by Simon Flexner, M.D. Philadelphia: J. B. Lippincott Company, 1926.

Medical Record Visiting List or Physician's Diary, 1927. New York: William Wood & Company, 1927.

Report on Third International Congress of Military Medicine and Pharmacy, Paris. April 1925. By William Seaman Bainbridge, M.C. Reprinted from the Military Surgeon, May to August, 1926, inclusive. Washington D. C., 1926.

Die Vorbereitung zu chirurgischen Eingriffen. By Dr. Med. Joh. Volkmann. Berlin: Julius Springer, 1926.

A Sound Economic Basis for Schools of Nursing and Other Addresses. By Mary Adelaide Nutting, R.N., M.A. New York: G. P. Putnam's Sons, 1926.

Chirurgie du Sympathique Périartériel des Membres. By R. Mathey—Cornat. Préface du Professeur Agrégé Jeanneney. Paris: G. Doin & Cie, 1926.

Shell Shock and its Aftermath. By Norman Fenton, Ph.D. St. Louis: The C. V. Mosby Company, 1926.

Diseases of Women. By Harry Sturgeon Crossen, M.D., F.A.C.S. 6th ed. rev. and enlarged. St. Louis: The C. V. Mosby Company, 1926.

Sketch of the History of the Mayo Clinic and the Mayo Foundation. Philadelphia: W. B. Saunders Company, 1926.

The Practice of Medicine. By A. A. Stevens, A.M., M.D. 2d ed. entirely reset. Philadelphia: W. B. Saunders Company, 1926.

The Treatment of Chronic Deafness by the Electrophonoïde Method of Zünd-Burguet. By George C. Cathcart, M.A., M.D. New York: Oxford University Press, 1926.

Self-Care for the Diabetic; for the use of Diabetic Patients. By J. J. Conybeare, M.C., M.D. Oxon., F.R.C.P. (Lond.) New York: Oxford University Press, 1926.

Chronic Rheumatic Diseases; their Diagnosis and Treatment. By F. G. Thomson, M. A. (Cantab.), M.D., F.R.C.P.(Lond.), and R. G. Gordon, M.D., D.Sc., M.R.C.P. (Edin.) New York: Oxford University Press, 1926.

The Treatment of the Acute Abdomen; Operative and Post-Operative. By Zachary Cope, B.A.,M.D., M.S. (Lond.), F.R.C.S.(Eng.). New York: Oxford University Press, 1926.

Reports of the St. Andrews (James Mackenzie) Institute for Clinical Research. St. Andrews, Fife vol. iii. Edited by Prof. David Waterston, M.D., F.R.C.S.E. New York: Oxford University Press, 1926.

The Life and Time of Adolf Kussmaul. By Theodore H. Bast, Ph.D. Foreword by William Snow Mille, M.D., D.Sc. New York: Paul B. Hoeber, 1926.

Pneumoconiosis (Silicosis); A Roentgenological Study with Notes on Pathology. By Henry K. Pancoast, M.D., and Eugene P. Pendergrass, M.D. New York: Paul B. Hoeber, 1926.

Atlas of the History of Medicine. Anatomy. By Dr. J. G. De Lint. Foreword by Charles Singer. New York: Paul B. Hoeber, 1926.

Biologie und Pathologie des Weibes; Ein Handbuch der Frauenheilkunde und Geburtshilfe. By Josef Halban and Ludwig Seitz. Lieferung 30. Berlin: Urban & Schwarzenberg, 1926.

Die Leitungsbahnen des Schmerzgefuehls und die chirurgische Behandlung der Schmerzzustaende. By Prof. Dr. O. Foerster. Berlin: Urban & Schwarzenberg, 1927.

Die Peripherischen Laehmungen; Diagnostik, Untersuchungstechnik, Prognostik und Therapie. By Prof. Dr. Toby Cohn. Berlin: Urban & Schwarzenberg, 1927.

A Doctor's Memories. By Victor C. Vaughan. Indianapolis: The Bobbs-Merrill Company, 1926.

Principles and Practice of Oral Surgery. By S. L. Silverman, D.D.S., F.A.C.D. Philadelphia: P. Blakiston's Son & Company, 1926.

International Clinics; a Quarterly of Illustrated Lectures and Especially Prepared Original Articles on Treatment, Medicine, Surgery, etc. Edited by Henry W. Cattell, A.M., M.D., with the collaboration of others. Philadelphia: J. B. Lippincott Company, 1926. vol. iv. 36th series, 1926.